“THEY UNDERSTAND THE LYRICS, BUT NOT THE MUSIC”: DIFFERENCES IN PROSODIC OUTPUT ACROSS PSYCHOPATHIC SUBTYPES

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This person-centered analytic approach identifies homogeneous offender subtypes in terms of psychopathic trait profiles and facilitates examination of correlates that may be linked with specific subtypes. Prosody is an external correlate that contains a wealth of information relevant to disruptions in cognition and affect and may offer novel insight into different psychopathic subtypes. The current study examined prosodic output in a male offender sample (n = 469) within the context of the clinical Psychopathy Checklist – Revised interview (PCL-R; Hare, 2003). Audio recorded speech samples were drawn from offender responses to affectively-charged PCL-R interview questions representing differing levels of valence and arousal. Generally consistent with previous literature, LPA results indicated that a four-class solution yielded the best model fit for the allocation of individual cases to subtypes with high overall classification accuracy (85%). Results of external validation analyses using mixed effects multivariate analysis of variance revealed significant two- and three-way interactions (psychopathy subtype x valence x arousal) for both speech production and variability indices that helped differentiate the subtypes. Overall, the current study suggests that meaningful differences exist in terms of prosodic output within psychopathic offender subtypes, which may be related to dysfunction in underlying affective processes. Implications of these findings and future directions for research are discussed.

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CHAPTER 1

INTRODUCTION

Natural speech provides an abundance of information relevant to understanding an individual's underlying psychological functioning, which can be conveyed through two primary channels of communication: *prosodic channels* (i.e., non-verbal aspects of spoken communication, such as intonation, inflection, and speech production) and *content channels* (i.e., semantic content; Cohen et al., 2009). Empirical evidence indicates that variance in affective and cognitive states can impact natural speech patterns, highlighting the inter-connections between affect, cognition, and verbal behavior (Barch & Berenbaum, 1994; Cohen & Docherty, 2005; Cohen et al., 2016a; Docherty et al., 1998). For example, Barch and Berenbaum (1994) found that alterations in vocal communication (e.g., syntactic complexity, pause patterns, verbosity) were positively associated with difficulty of experimentally-manipulated cognitive load in a sample of college students. Further, paradigms intended to induce negative mood states have been shown to exacerbate dysfluency in natural speech in non-psychiatric controls, providing evidence for affective reactivity in speech (Docherty et al., 1998).

Studies have consistently demonstrated that specific patterns of disturbance in natural speech output are linked to a range of specific forms of psychopathology, including depression, anxiety, and schizophrenia, as well as to individuals receiving psychiatric services more broadly (Cohen et al., 2016; Cowen et al., 2018; Cummins et al., 2015; Mundt et al., 2012). With regards to differences in semantic channels of communication, evidence has shown that writing samples of psychiatric inpatients demonstrate significantly fewer references to bodily and somatic concerns, optimism, the future, basic cognitive functions, and communication with others when compared to non-psychiatric controls (Junghaenel et al., 2008). Further, a study by Pennebaker

and colleagues (2003) examined linguistic indicators of recovery in transcribed speech samples and found that a pattern of decreased use of negatively valenced emotion words and increased use of positively valenced words was associated with significant symptom amelioration and recovery from symptoms of depression (Pennebaker, Mehl, & Neiderhoffer, 2003). Relatedly, decreased use of both positive and negatively valenced affectively-charged words has been found in psychiatric inpatients with high levels of alexithymia (Tull, Medaglia, & Roemer, 2005). Abnormally high rates of negatively valenced word use across both positive and negative situations when recounting emotionally charged memories has also been shown in psychiatric inpatients diagnosed with schizophrenia and schizoaffective disorder (Cohen, Minor, Baillie, & Dahir, 2008).

Changes in prosodic channels of communication have also been documented in response to treatment and severity of affective disturbance in patients with depression (Cummins et al., 2015; Mundt et al., 2012) and schizophrenia (Cohen, Alpert, Nienow, Dinzeo, & Docherty). In a large sample of psychiatric inpatients, Cummins and colleagues (2018) found that overall diminished prosody (e.g., less variance in intonation, diminished speech production) was associated with more severe depressive symptomology and increased suicidal ideation. The authors suggested that findings related to diminished speech production were conceptually related to psychomotor retardation commonly seen in depressive disorders, while the intonation findings may be reflective of “flat affect” (Cummins et al., 2015). Interestingly, an inverse pattern of prosodic output has been demonstrated in patients recovering from a depressive episode, with recovered patients demonstrating greater variance in intonation, inflection, and fluidity of speech (Mundt et al., 2012). Also, computerized acoustic analysis software has shown utility in differentiating between clinically-rated flat versus non-flat affect in psychiatric

inpatients with schizophrenia, as well as delineating between patients with schizophrenia and controls in terms of clinician-rated alogia (Cohen, Alpert, Nienow, Dinzeo, & Docherty, 2008).

Recent evidence has further demonstrated that differences in prosodic output can be seen across a continuum of schizophrenia-spectrum disorders, including subclinical samples (Cohen et al., 2014; Cohen et al., 2016; Minor et al., 2015). For example, during an experimental manipulation of natural speech and cognitive load, undergraduate students with elevated levels of psychometrically-defined schizotypy did not demonstrate the expected increased dysfluency under increased cognitive load and, somewhat paradoxically, were both more fluent in terms of prosodic output and evidenced more accurate performance on high cognitive load tasks than undergraduates without significant elevations in schizotypy (Cohen et al., 2014). However, recent studies have provided evidence for emergent pathological differences in prosody in college students with psychometrically-defined schizotypy in response to task demands for retrospective, autobiographical memories of differential valence and arousal levels in comparison to controls (Minor et al., 2015). Specifically, one study found that individuals with schizotypy showed significantly impaired fluency (e.g., greater average pause length, increased pause frequency, increased latency to initial utterance) when introduced to pleasant and unpleasant valenced tasks compared to controls (Minor et al., 2015). These latter findings signify the importance of considering the context (e.g., valence) in which natural speech is generated and highlight the potential for capturing aspects of speech dysfluency across a variety of affective and cognitive contexts, rather than focusing on singular, narrowly defined tasks.

Evidence demonstrating significant differences in language across diagnostic groups provides compelling evidence that the empirical study of natural speech represents a unique opportunity for researchers to observe manifestations of psychological processes beyond the

scope of traditional self-report or clinician-rated measures (Hancock, Woodworth, & Porter, 2013; Pennebaker, Mehl, & Niederhoffer, 2003). Experimental paradigms focused on assessment of natural speech typically rely upon digitized samples of vocal communication which are subsequently subjected to different objective, computerized analysis programs (e.g., PRAAT; Boersma, 2001; LIWC; Pennebaker, Mehl, & Neiderhoffer, 2003), based on the channel of communication that is being assessed. Content channels have been historically assessed using linguistic analysis methods on extended speech samples, which analyze verbal behavior and expression through quantification of the specific types of words used within various "dictionary" categories, without consideration of the narrative context in which the speech occurred (Pennebaker & King, 1999; Pennebaker, Mehl, & Neiderhoffer, 2003). On the other hand, prosodic channels tend to be conducted using highly controlled emotion-induction procedures on relatively brief vocalizations (e.g., three to five seconds) and are traditionally analyzed using acoustic analysis software.

Delineating Features of Prosodic Channels of Natural Speech

While computerized assessments across channels of vocal communication have demonstrated their utility in providing unique insight into underlying psychological functioning, it is critical to consider the impact of contextual and individual difference variables when interpreting their output. The literature has consistently demonstrated the impact of a number of environmental and individual difference variables on significant variability in natural speech output including affective context of the probe (Batliner, Steidl, Hacket, & Nöth, 2008), arousal (Cohen, Hong, & Guevara, 2010), and cognitive influences (e.g., increased cognitive load, stress, working memory; see Cohen, Dinzeo, et al., 2015). In addition to a careful consideration of contextual factors, it is important to determine the scope of the acoustic analysis, or whether

microscopic or macroscopic analyses of speech are employed (Cohen et al., 2016b). *Microscopic* level analyses utilize relatively brief samples and therefore focus on providing information on the physical processes (e.g., motor anomalies) involved in speech (Kent & Kim, 2003). However, *macroscopic* level analyses differ in their utilization of extended samples of speech (typically > 30 seconds), and thus can provide aggregate statistics of speech production and variability in speech across both a single sample and multiple samples from a single individual (Cohen et al., 2016b). The extended scope of "macro" analyses affords the opportunity to conduct more stable assessments of language phenomena across speech samples, and therefore link it to associated psychological processes (e.g., cognitive deficits; Cohen et al., 2016b).

The computerized assessment of natural speech (CANS) is an automated protocol developed by Alex Cohen and colleagues (Cohen et al., 2009) to assess channels of vocal communication by joining methodologies from both content and prosodic analyses with a focus on macroscopic level analyses. The CANS has provided numerous advantages in examining vocal communication in both laboratory and natural environment settings, given that the valence, intensity, and modality of the emotion-induction stimuli and paradigms related to cognitive load can be varied, allowing for concurrent examination of a range of conceptually relevant variables (Cohen et al., 2009; Cohen et al., 2016a). Further, the CANS has demonstrated its utility in examining the impact of contextual variables related to psychological processes on speech production across a wide variety of samples, including community adults (Cohen, Dinzeo et al., 2015), undergraduates (Cohen et al., 2009), psychiatric outpatients (Cohen et al., 2016a), and long-term forensic psychiatric inpatients (Cohen et al., 2016b). Although the vast majority of previous literature assessing natural speech through use of CANS protocol have primarily focused on differences across schizophrenia-spectrum disorders, the relevant applications of the

CANS to cognitive and affective processes lends itself to research on a wide variety of psychopathological conditions. One such condition in which there is significant disruption in both cognitive and affective domains, which could be captured in natural speech, is psychopathy.

Psychopathy: A Brief History of the Construct and Its Assessment

Psychopathy is a clinical syndrome characterized by a constellation of covert (e.g., manipulative and deceptive interpersonal style, calloused use of others, lack or empathy or remorse, blunted affect) and overt (e.g., impulsivity, boredom proneness, poor behavioral controls, criminal versatility) antisocial personality traits and tendencies (Hare, 2003; Neumann, Hare, & Newman, 2007; Hare & Neumann, 2008). Although the prevalence of psychopathy within the general population is roughly 1%, individuals with psychopathy constitute approximately 15 to 25% of incarcerated male offenders (Hare, 2003). The literature has consistently shown that compared to non-psychopathic offenders, offenders with psychopathy demonstrate a more severe, persistent and escalating pattern of violent offenses, are more likely to cause more serious harm to victims of their violent offenses, and engage in more institutional misconduct and violence while incarcerated (Edens, Polythress, Lilienfeld,& Patrick, 2006; Lawing, Frick, & Cruise, 2010; Leistico, Salekin, DeCoster, & Rogers, 2008; Porter & Woodworth, 2006). Further, it has been estimated that psychopathy represents a cost of approximately $460 billion per year within the context of the criminal justice system (Kiehl & Hoffman, 2011). Given the immense financial and societal cost that psychopathy poses, research has focused on developing assessments of the construct and identifying its unique associations with relevant external correlates. Modern research on psychopathy has advanced exponentially due to the development of the Psychopathy Checklist (PCL: Hare, 1985) and its revisions (PCL-R; 1991; 2003), which have provided both reliable and valid assessments of psychopathic

personality across diverse populations (Krstic et al., 2017; Mokros et al., 2015; Neumann, Hare, & Pardini, 2014; Neumann, Vitacco, & Mokros, 2016).

Briefly, the PCL-R is a clinical construct rating scale of twenty items theoretically and empirically related to psychopathy. PCL-R ratings are provided on the basis of on information obtained from a standardized, semi-structured interview, extensive file history review, and scoring criteria provided within its manual. Although initially developed for research purposes, evidence for its utility for the prediction of violence and recidivism has led to the adoption of the PCL-R in forensic settings for the purpose of risk assessment and sexually violent predator evaluations (Hare, 2007; Leistico et al., 2007; Quinsey et al., 2006). The PCL-R statistically represents psychopathy as a superordinate construct underpinned by four correlated homogenous dimensions inherent to the construct: *Interpersonal* (e.g., conning/manipulative interpersonal style, superficial charm, pathological lying), *Affective* (e.g., calloused lack of empathy, lack of guilt or remorse, shallow affect), *Lifestyle* (e.g., proneness for boredom, impulsivity, parasitic lifestyle), and *Antisocial* (e.g., poor behavioral controls, early behavioral problems, criminal versatility) (Hare & Neumann, 2008; Krstic et al., 2017; Mokros et al., 2015; Neumann & Hare, 2008). An extensive body of evidence has emerged providing support for the four-factor model using multiple PCL-based measures (e.g., the PCL:SV, SRP-SF, B-SCAN) across a diverse array of populations (Krstic et al., 2017; Mokros et al., 2015; Neumann, Hare, & Pardini, 2014; Neumann, Vitacco, & Mokros, 2016), providing additional support for its psychometric utility.

The use of the four-factor model has proven particularly advantageous in variable centered approaches to conceptualizing relationships between psychopathic traits and relevant external correlates (e.g., substance use, instrumental and reactive aggression), such as structural equation model (SEM), given that each unidimensional trait domain has differential associations

with a variety of relevant external correlates (e.g., Hoppenbrouwers, Neumann, Lewis, & Johansson, 2015; Neumann, Hare, & Johansson, 2013; Vitacco, Neumann, & Jackson, 2005). Although variable-centered studies have advanced our understanding the links between psychopathic traits and various external correlates across large samples of individuals, they do not address research questions considering the function of psychopathic traits at the person-centered level. Given evidence suggesting considerable systematic heterogeneity among offenders with psychopathic traits (Colins et al., 2018; Decuyper et al., 2013; Hicks et al., 2010; Klein Haneveld et al., 2018; Krstic et al., 2018), research utilizing person-centered analyses, such as latent profile analysis (LPA) and cluster analysis, provide the potential to identify subtypes in terms of distinct psychopathic trait profiles. The identification and empirical validation of subtypes of psychopathy allows for a more nuanced exploration of the relationship between external correlates and psychopathic traits at the within person level. As such, a brief overview of previous literature concerning subtypes of psychopathic personality and their relationship both to relevant external correlates (e.g., treatment responsiveness, violence risk, trait anxiety) and etiological distinctions is presented below.

An Overview of the Literature Concerning Psychopathy Subtypes

The identification of subtypes of psychopathic personality is a long-standing area of interest within the field, dating back to the work of Karpman (1955) and Arieti (1963). In his initial works, Karpman (1955) suggested the presence of two fundamentally different subtypes of psychopathy, which were proposed to differ on the basis of etiology, motivations for engagement in criminality, symptom expression, and outcome trajectory. Briefly, *primary psychopaths* were conceptualized as having a significant hereditary component related to an emotional deficit associated with low anxiety and fearlessness. In contrast, *secondary psychopaths* were theorized

as having acquired traits due to aversive experiences in earlier childhood, as well as being characterized by higher levels of anxiety and fear (Colins et al., 2018; Mokros et al., 2015; Skeem et al., 2007). Karpman further argued that although primary and secondary variants were virtually indistinguishable in terms of criminal outcomes, their trajectories towards these outcomes vastly differed (Colins et al., 2018; Karpman, 1955). In terms of treatment outcome, it was hypothesized that secondary psychopaths would be more likely to benefit from therapy, while primary variants would be essentially untreatable and unlikely to show improvement through psychotherapy (Karpman, 1955), though recent research has shown this view to be overly pessimistic (see, Klein Hanevald et al., 2018).

However, it is important to note that more recent research has demonstrated that a simplistic dichotomy between heredity versus environmental etiological factors for understanding subtypes of psychopathy is unlikely (Tuvblad et al., 2017). Nevertheless, it is useful to highlight that research has supported the proposal by Karpman (1955) suggesting the existence of two primary subtypes with high elevations across all four psychopathic trait domains that share similar motivations for engagement in criminal behavior, but differ in terms of interactional style: *aggressive/predatory* (i.e., characterized by more pronounced elevations on Antisocial traits and utilize more overt aggressive strategies for purpose of coercion such as violent and intimidation) versus *passive/parasitic* (i.e., characterized by more pronounced Interpersonal traits and utilize more covert aggression and coercive strategies such as manipulation and deception; Mokros et al., 2015).

Arieti (1963) elaborated upon Karpman's original work, suggesting that trajectories towards aggressive outcomes differed in terms of approach and motivation with respect to simple versus complex psychopaths. Arieti's "true" variants of primary psychopathy can be

distinguished such that *simple psychopaths* possess the basic understanding of how to engage in criminal or aggressive behavior, whereas the *complex psychopath* possesses the cunning and wit to understand "how to do it and get away with it" (Arieti, 1963, pp. 307 – 308). Arieti further described a group of individuals who were fundamentally dissocial with regards to general society, but loyal to members within their own group, akin to Lykken's (1995) description of a "sociopath" (or secondary psychopath).

In contrast to a pathological view of psychopathic personality, evolutionary theorists have hypothesized that psychopathy represents an adaptive strategy to ensure fitness and reproductive success (Book & Quinsey, 2004; Harris, Rice, Hilton, Lalumiére, & Quinsey, 2007; Mokros et al., 2015). From an evolutionary standpoint, it has been argued that psychopaths ensure their fitness to reproduce through use of *cheater* (e.g., interpersonal manipulation, use of deception, selfishness, callousness) and *warrior-hawk* strategies (e.g., impulsivity, aggression, violence; Book & Quinsey, 2004). Psychopaths' use of cheater and warrior-hawk strategies can be presumed to vary among individuals, as well as across contexts and time.

Within the context of evolutionary theory, Mealey (1995) proposed a model of subtypes of psychopathic personality in line with historical conceptualizations. Consistent with previous theorists (e.g., Karpman, Arieti), Mealey (1995) suggested that primary psychopaths use of deceptive strategies was heavily influenced by genetically-based personality and behavioral dispositions, whereas secondary psychopaths were more influenced by adverse social and environmental conditions in early childhood. As such, Mealey (1995) posited that the heritability of secondary psychopathy should be relatively low, predominantly found in lower socioeconomic status backgrounds, have equal rates across gender, and vary in terms of engagement in antisociality across the lifespan. In contrast, psychopathic traits for the primary

variant should be highly heritable, predominantly male, found across socioeconomic status backgrounds, be relatively uncommon, and exhibit consistent antisociality across the lifespan (Mealey, 1995). While some authors continue to hold to the idea of psychopathy as an adaptive evolutionary strategy, the evidence suggests that, at best, there are both positive (fertility) and negative (infant mortality) trade-offs (Neumann, Schmitt, et al., 2012). Moreover, individuals with psychopathic personality die younger than do those without this personality pathology, and the causes of death are more violent compared to healthy and non-psychopathic-offender comparison groups (Vaurio et al., 2018). Also, while individuals with psychopathic personality traits commit more crimes, they do not have an advantage when it comes to avoiding arrests (Boccio & Beaver, 2018).

Empirical evidence utilizing cluster analytic techniques has amassed providing support for subtypes of psychopathic personality (Hicks et al., 2010; Poythress et al., 2010; Skeem et al., 2007), as well as for further subvariants of primary psychopathy (Klein-Haneveld et al., 2018; Krstic et al., 2018; Mokros et al., 2015). Primary and secondary variants of psychopathy have been consistently shown to differ in terms of profiles using PCL-R factor scores and levels of trait anxiety in recent studies using model-based cluster analysis (Hicks et al., 2004; Hicks et al., 2010; Olver et al., 2015; Poythress et al., 2010; Skeem et al., 2007). Individuals within the primary psychopath cluster in previous studies have shown high scores across all four facets of the PCL-R (Hare, Neumann, Mokros et al., 2018), with some earlier studies finding prominent elevations in interpersonal and affective trait domains as well as lower levels of trait anxiety (Hicks et al., 2004; Hicks et al., 2010; Olver et al., 2015; Poythress et al., 2010; Skeem et al., 2007). In contrast, those who typify the secondary psychopath cluster evidence relatively fewer interpersonal and affective traits and higher levels of trait anxiety, as well as greater elevations in

lifestyle and antisocial trait domains (Hicks et al., 2010; Olver et al., 2015; Poythress et al., 2010). Secondary psychopathic offenders additionally have demonstrated greater affective and behavioral instability (e.g., engagement in impulsive behaviors, volatile emotional outbursts, use of affectively-charged aggression), as well as higher rates of general psychopathology (Hicks et al., 2010; Olver et al., 2015). In this context, these noted differences in presence of negative affect among certain subtypes of psychopathy should play a role in influencing features of natural speech. For instance, individuals with PCL-R profiles that are relatively higher on impulsive Lifestyle and Antisocial features than Affective and Interpersonal features, should show differences in prosody, compared to those elevated primarily on the latter trait domains. This would be due to the link between negative affective and Lifestyle and Antisocial features of psychopathy.

Both classic test theory and empirical evidence using model-based cluster analytic techniques in offender samples have provided evidence for a basic distinction between primary and secondary psychopaths. However, these studies have relied on an extreme sample approach, rather than considering potential distinctions in subtypes across offenders representing a continuum of PCL-R total scores. Studies using LPA in large, diverse samples of offenders have consistently identified a four-class solution distinct from ideas of primary versus secondary variants seen in extreme sample approaches, with two classes (subtypes) displaying elevations on the Interpersonal and Affective features. More specifically, the four-class solution finds evidence for a *prototypical subtype* with elevations on Interpersonal and Affective domains, as well as the Lifestyle and Antisocial domains, and also a *callous-conning* variant with elevations only on the two former domains. A class emerges that is consistent with descriptions of *secondary psychopaths* that aligns with more recent depictions of the *externalizing psychopath* (high

Lifestyle, Antisocial features), as well as a final class, with low scores on all PCL-R trait domains, representing a *non-psychopathic general offender* class (Driessen et al., 2018; Klein Haneveld et al., 2018; Krstic et al., 2017; Mokros et al., 2015). While both prototypical and callous-conning subtypes display high affective and lifestyle facet scores, the prototypical variant evidence the highest elevations across all four trait domains while the callous-conning variant shows higher elevations on the interpersonal and affective than lifestyle and antisocial trait domains. The third subgroup representing externalizing psychopaths (i.e., consistent with past depictions of secondary psychopathy or "sociopaths") exhibits lower interpersonal and affective scores and higher scores on the lifestyle and antisocial trait domains (Driessen et al., 2018; Klein Haneveld et al., 2018; Krstic et al., 2017; Mokros et al., 2015).

Klein-Haneveld et al (2018) utilized latent profile analysis in a study of male violent offenders in the Netherlands using the full-range of PCL-R scores. Their results provided support for a four latent-class solution, which they identified as *prototypical psychopaths* (high elevations across all four facets), *callous-conning psychopaths* (elevated on interpersonal and affective facets, lower scores on lifestyle and antisocial facets), *sociopaths* or *externalizing psychopaths* (low on interpersonal traits, higher elevations on remaining facets with a total score of approximately 20), and *non-psychopathic offenders* (non-significant elevations in psychopathic traits). The authors further examined distinctions across variants in terms of recidivism rates and treatment outcomes. Specifically, prototypical psychopathic offenders were significantly more likely to prematurely drop out of treatment than the other three classes (Klein-Haneveld et al., 2018). However, prototypical psychopaths who completed treatment demonstrated similar progression through various treatment phases as the other groups (Klein-Haneveld et al., 2018). Individuals elevations on the Interpersonal and Affective domains were

significantly more likely to fail treatment programs, and were at particularly high risk during the initial stages of treatment (Klein-Haneveld et al., 2018). Similarly, these subtypes were more likely to be transferred to a new hospital by their clinician prior to completing the treatment program. Finally, the authors found that, contrary to expectations, individuals within the prototypic and externalizing classes had comparably high rates of recidivism, while those within the callous-conning psychopathy and non-psychopathic classes had relatively lower recidivism rates (Klein-Haneveld et al., 2018).

Similarly, utilizing the full range of PCL-R total score in a sample of sexual offenders, Krstic et al (2018) found support for a four-class solution representing prototypical psychopaths (C1), callous-conning psychopaths (C2), sociopathic or externalizing psychopathic offenders (C3), and non-psychopathic general offenders (C4). Critically, the authors were able to replicate previous findings with regards to patterns of PCL-R trait domain elevations across the four identified latent classes (Hare, Neumann, & Mokros, 2018; Klein Haneveld et al., 2018; Krstic et al., 2018). Further, Krstic and colleagues' (2018) found distinctions across the subtypes in terms of sexual offending behaviors. Specifically, inmates within the prototypical psychopath class demonstrated the highest level of violent and control sexual offenses compared to other groups, while those in the callous-conning psychopathic class evidenced the highest rates of paraphilic sexual offenses and those in the general offender class showed the highest rates of purely sexual behavior offenses (Krstic et al., 2018).

In sum, the literature has demonstrated the utility of identifying variants of psychopathic personality, which may offer a better understanding of the diverse etiologies involved in psychopathy and how these translate to the heterogeneous expressions of this pathological personality disorder. Previous studies using the full range of PCL-R total scores have found that

prototypical psychopathy is associated with higher rates of sexually violent offenses (Krstic et al., 2017), higher rates of violent recidivism (Klein Haneveld et al., 2018), and higher risk for drop out from treatment while incarcerated (Klein Haneveld et al., 2018). Callous-conning psychopaths, on the other hand, have been shown to be at a heightened risk for failing treatment programs (Klein-Haneveld et al., 2018) and demonstrate higher rates of paraphilic sexual offenses (Krstic et al., 2018). Finally, the classic category of secondary psychopaths or "sociopaths" have shown comparatively greater responsivity to treatment (Klein Haneveld et al., 2018) and lower rates of recidivism than primary variants (Krstic et al., 2017, Klein Haneveld et al., 2018).

The PCL-R and Adjunctive Assessments of Psychopathy

A more nuanced understanding of the potential distinctions among the PCL-R-based subtypes may be obtained through the use of adjunctive assessment tools for measuring the construct. While the PCL-R remains the international gold standard for the assessment of psychopathy and has enabled considerable advancement in our understanding of the construct and its associations with relevant outcomes, there are some important considerations regarding its use. As with any semi-structured clinical interview, the PCL-R necessitates extensive training with skilled researchers and clinicians to properly administer and interpret it. As such, there are some practical consideration regarding its use, given the expense and time needed to competently train professionals in the administration of the PCL-R, as well as the low base rate of clinically significant elevations in psychopathy in the general population. Thus, scholars have sought to identify supplementary means of evaluating psychopathic traits, which could potentially be used to augment expert rated PCL-R assessments without exorbitant cost. For example, results of a study by Fowler et al (2009) showed that undergraduates and community lay observers could

effectively detect psychopathic features from “thin slices” of behavior (i.e., brief samples of audio and video recorded interviews with offenders), with ‘thin slice’ ratings positively associated with expert-derived PCL-R ratings. Importantly, these findings demonstrating the utility of “thin slice” ratings by lay observers in detecting psychopathic traits have since been replicated by ten Brinke and colleagues (2017). These studies highlight the incremental utility of examining audio and video recordings of behavioral markers within digital PCL-R based interviews, which can be extracted to further understand phenotypic distinctions within individuals with psychopathic personality traits.

A movement towards objective, automated assessments of behavior, such as computerized analyses of vocal communication, may be a particularly useful adjunctive tool to formal psychopathy measures like the PCL-R. Such measures may be particularly useful for augmenting the assessment of affective features in a population that is, by definition, manipulative, deceptive, and glib in their interactions with others. These computer-based measures are not only relatively inexpensive to administer and interpret, but the resources necessary for these evaluations are widely available and can provide multiple assessments of individuals in correctional facilities. As such, the inclusion of automated, objective measures in the formal assessment of psychopathy offer valuable adjunctive information along with formal, diagnostic measures and self-report instruments to provide a more complete picture of affective and cognitive functioning in individuals with psychopathic personality. As will be discussed below, research has been moving in the direction of using objective assessments of language processing in psychopathy. The results of these studies suggest further in-depth analysis of language, prosody especially, may be a productive avenue to pursue.

Affective Processing and Vocal Communication in Psychopathy

With regards to vocal communication, the study of semantic channels of psychopathic speech represents a long-standing area of interest in the literature, with a significant focus on both the expression and recognition of affective states. In his initial clinical description of the construct, Cleckley (1976) proposed that psychopaths "understand the lyrics, but not the music" in terms of comprehending the nuances of affectively charged language. Specifically, Cleckley (1976) suggested that psychopathy is characterized by a fundamental semantic disorder in which the semantic and affective components of language are separated. Cleckley (1976) further posited that psychopaths are characterized as using "empty language" as a tool for the exploitation and manipulation of others. At the same time, it is important to recognize that Cleckley did not have advanced imaging facilities or acoustic analysis technologies to actually document such a disorder. More importantly, it is clear that psychopathic individuals often perform differently than non-psychopathic counterparts, but this difference does by no means demonstrate that one group displays an actual deficit in a true neurobiological sense (Hare, 2016).

Both clinical descriptions and empirical research have supported the notion that the affective features observed in psychopathy do not pertain to problems in comprehending the lexical meaning of language, but rather a failure (in a non-deficit sense) or lack of motivation to assimilate the underlying affective nuances of the semantic content with the meaning of the word (Blair et al., 2006; Hare, 1993). Indeed, a vast literature has emerged in support of specific disturbances or differences in affect recognition in lexical decision tasks in psychopathy. For example, studies examining reaction times in response to lexical decision tasks have demonstrated that psychopathic offenders show no difference in reaction time between

affectively-charged and neutral words, and thus do not exhibit the typical *priming effect* (i.e., faster reaction times to affectively-charged versus neutral words) observed in non-psychopathic offenders (Lorenz & Newman, 2002; Williamson et al., 1991). When asked to rate the affective valence of words in semantic priming tasks, individuals with psychopathy demonstrated significantly reduced affective priming in terms of reaction time and are generally more likely to rate neutral words as positively valenced when compared to non-psychopathic controls (Blair et al., 2006). Studies have found that psychopathy is associated with decreased efficiency in processing negatively-valenced words in terms of reaction time, with greater difficulty associated with more abstract versus concrete verbal stimuli (Long & Titone, 2007). Furthermore, Long and Titone (2007) found that individuals with elevated psychopathic traits were less accurate in their ratings of negatively valenced affective words.

Robert Hare (1993; Williamson, Harpur, & Hare, 1991) also suggested that a failure to process subtleties related to the emotional dimension of language is a core aspect of the personality pathology. In a classic empirical paradigm, Hare, Williamson, and Harpur (1988) instructed male offenders to cluster words in terms of their relatedness to either affectively-charged or neutral word lists. Psychopathic offenders exhibited a propensity to cluster words based solely on lexical characteristics rather than considering their affective connotation, whereas non-psychopathic controls grouped words primarily based on affective dimensions (Hare, Williamson, & Harpur, 1988). Results of dichotic listening tasks provide additional support for differences in language lateralization with respect to emotionally-charged speech (Hiatt, Lorenz, & Newman, 2002). In a sample of male offenders, Hiatt et al (2002) found that although psychopaths demonstrated a normal right-ear advantage for target words, they exhibited a reduced left-ear advantage in distinguishing emotion word targets. As such, the authors posited

that the observed differences in language lateralization processing in psychopathy arise primarily in response to complex, affectively charged tasks and may potentially be related to disturbances in interhemispheric integration (Hiatt, Lorenz, & Newman, 2002). The findings of neurological studies illustrating differences in cortical activity when processing emotional information in language provide further support for Hare's claim that affective processing differs in psychopathic individuals. Using cortical electroencephalography (EEG) techniques, Kiehl et al (1999) found that individuals with psychopathy evidenced less activation in the amygdala and anterior cingulate cortex, areas of the brain relevant to emotion and attentional processes, when asked to memorize a list of more abstract compared to concrete emotionally-charged words.

Empirical evidence has further found support for differences in terms of vocal affect recognition tasks with regards to both prosodic and semantic cues in individuals with psychopathic traits (Blair, Mitchell, Richell, Kelly, Leonard, Newman, & Scott, 2002; Bagley, Abramowitz, & Kosson, 2009). Individuals with psychopathy have consistently demonstrated less ability (or it might be less motivation) to recognize emotionally relevant prosodic cues, with specific differences observed with respect to recognition of fearful and sad affect, across offender, community, and undergraduate samples (Blair et al., 2002; Blair et al., 2006; Dawel, O'Kearney, McKone, & Palermo, 2012; Dawel, Wright, Dumbleton, & McKone, 2018). The differences that psychopathic individuals display with respect to processing emotional information presented through others' language has implications not only for the present-oriented cognitive style of individuals with psychopathy described in the literature (see Brinkley, Newman, Harpur, & Johnson, 1999), but also for the individual's capacity to perceive other's expressed emotions (see Dadds et al., 2011).

These observed differences have led to the development of an etiological theory of the

affective features of psychopathy (Blair, 2005). Briefly, Blair (2005) proposed that there are actual “impairments” in processing of distress cues of others (e.g., fearful and sad expression) and that these are central to the affective features of psychopathy. This theory suggests that typical individuals experience aversive, negative arousal in response to others’ distress cues, which serves as a punishment to potential antisocial behavior causing the distress and motivates the individual to change their behavior. Blair (2005) suggests that this mechanism is essentially impaired in individuals with psychopathy, which may be related to underlying dysfunction in the amygdala. Thus, Blair (2005) posits that individuals with psychopath exhibit a lack of aversive arousal in response to others distress, which may lead to a failure to inhibit antisocial behavior.

The difficultly with this deficit or ‘impairment’ theory is that differences in behavioral performance or brain activation patterns do not necessarily demonstrate an actual impairment (Hare & Neumann, 2010). Moreover, recent research has demonstrated that emotional areas of the brain (e.g., limbic system) can actually be activated by psychopathic individuals if you ask them to do so (Shane & Groat, 2018). Nevertheless, the observed differences (or perhaps we might refer to them as ‘disturbances’ whether they be motivational or neurobiological), remain a meaningful target for understanding psychopathy. The literature consistently highlights psychopathic differences in processing the subtleties of affectively-charged information available through language in both lexical decision tasks and affect recognition tasks, and identified potential neurological mechanisms underlying these differences. However, a more limited body of literature has examined emotional expression in psychopathy, which provide further information regarding the affective processes central to the construct.

Previous studies have shown significant differences in affective expression with regards to the semantic content of both written and vocal samples of communication in individuals with

psychopathy. Such language differences may reflect a generalized disturbance in psychopathic individuals' ability to regulate and interpret emotion within themselves as well as others (Garofalo & Neumann, in press; Garofalo, Neumann, Zeigler-Hill, & Meloy, 2018; Hoppenbrouwers et al., 2015). Specifically, psychopathy has been associated with disturbances in storing and recalling affectively-charged autobiographic and factual information (Dolan & Fullam, 2005), as well as difficulty describing the emotional context of their actions or focusing on negative aspects of the situation within autobiographical recall tasks (Dolan & Anderson, 2002). One interpretation of this set of findings, in combination of those found in schizophrenia research and the aforementioned findings of dichotic listening and lexical decision tasks, is that language-related disturbances become evident for psychopathic individuals when affective arousal levels inherent to task demands increase (i.e., situations requiring emotion regulation).

There is a notable dearth of literature considering semantic channels of communication in psychopathy. However, one study found the language of psychopathic offenders convicted of homicide in response to probes inquiring as to details of their offense was characterized by less intense emotion word use and greater utilization of past tense verbs, suggestive of greater psychological distancing and emotional detachment (Hancock, Woodworth, & Porter, 2013). Such findings suggest that offenders with psychopathy convicted of homicide may be more emotionally detached from their previous criminal behavior than a non-psychopathic offender than non-psychopathic offenders (Hancock et al., 2013). Further, Hancock et al (2013) found that speech produced by homicide offenders with significant elevations in the Interpersonal and Affective trait domains were characterized by less intense emotional words throughout the sample, as well as a greater proportion of negatively valenced words compared to non-psychopathic offenders and psychopathic offenders with lower levels of Interpersonal and

Affective traits. Such findings are consistent with results of a "thin slice" assessment studies, which indicated that psychopathic speech was characterized by greater use of negatively valenced emotion words (Fowler et al., 2009; ten Brinke et al., 2017).

Finally, Hancock and colleagues' (2013) results indicated that speech output of offenders with elevated psychopathic traits was characterized by greater instances of disfluency (e.g., "uh", "um"), particularly in those with pronounced elevations in Interpersonal and Affective trait domains. The observed positive association between disfluency in speech and Interpersonal and Affective traits of psychopathy is intriguing, given that increased verbal disfluencies has been documented in response to multiple cognitive choices or increased demands (Schachter, Christenfeld, Ravina, & Bilous, 1991). When taken in the context of evidence showing differences in processing emotionally-charged content related to language at the neurobiological level (see Bagley et al., 2009; Intrator et al., 1997; Kiehl et al., 1999; Williamson et al., 1991), the findings of increased disfluency of language in psychopaths high in Interpersonal and Affective traits (while recalling details of their homicide) appear to suggest that communicating emotional context represents an area of increased cognitive demand in those with psychopathic traits.

Studies examining prosodic distinctions in psychopathic speech are even more limited than those examining semantic processes. This is particularly surprising, given that prosodic channels of communication fundamentally involve the expressive aspects of emotion in speech. Results of neurobiological studies of affective expression indicate that the basal ganglia and amygdala play a significant role in prosodic expression in adults without brain injury, and that injury to these areas results in increased dys-prosody (Van Lancker, Sidtis, Pachana, Cummings, & Sidtis, 2006). Importantly, consistent differences in amygdala functioning have been noted in

both adults (see Kiehl, 2006) and adolescents (Marsh et al., 2013) with psychopathic traits, such that psychopathic traits were associated with decreased amygdala activation to in response affectively charged stimuli when compared to non-psychopathic controls. However, recent evidence indicates psychopaths experience hyperactivation of the amygdala in response to fear conditioning cues, suggesting the observed differences in psychopaths' ability to recognize affect in others may be reflective of a lack of motivation or perhaps affective dysregulation (Schultz, Balderston, Baskin-Sommers, Larson, & Helmstetter, 2016). Given noted disturbances with regards to psychopaths' ability (or motivation) to recognize prosodic cues relevant to affective state in others (Bagley, Abramowitz, & Kosson, 2009; Blair et al., 2002; Blair, 2005; Dawel et al., 2012), an examination prosodic channels of natural speech output may provide an important avenue for conceptualizing the affective features central to the construct.

What little research that has been conducted examining prosodic distinctions in psychopathy have primarily utilized subjective ratings of speech output provided by trained research assistants. In one study of nonverbal indicators of deception in currently incarcerated males, psychopathic traits were associated with subjective ratings of being more verbose, a faster rate of speech, and increases in speech hesitations and indicator use (Klaver, Lee, & Hart, 2007). However, subjective ratings of prosody are inherently limited, given a lack of reliable statistics of distinct dimensions of prosodic outputs. Current empirical evidence considering prosodic distinctions in psychopathic speech utilizing objective, computerized assessments have primarily focused on "microscopic" aspects of natural speech using relatively brief speech samples. For example, de Almeida Brites et al (2015; 2016) did not find significant differences between psychopathic and non-psychopathic offenders in terms of fundamental phonetic qualities and phonological processes. As such, the authors suggested that psychopathic offenders exhibit basic

language competencies and motor capacities (de Almeida Brites, 2016; de Almeida Brites et al., 2015). While such “micro” level analyses offer basic data regarding physical motoric processes necessary for speech, they are unable to provide aggregate statistics of speech production necessary to indicate more stable phenomena (e.g., ‘disturbances’ in cognitive and affective processing) across samples available through analyses of “macroscopic” aspects of speech.

A preliminary “macroscopic” level analysis utilizing early acoustic analysis technologies (e.g., PRAAT) in a male offender sample concluded that psychopathic offenders not only spoke more quietly and slowly when describing emotional content, but also did not differentiate in terms of emphasis between neutral and affectively charged words (Louth, Williamson, Alpert, Pouget, & Hare, 1998). However, the early technologies utilized by this study may have failed to recognize more nuanced prosodic differences in psychopathic speech and suffered from a small sample size (n = 20). Thus, no study to date has examined sophisticated and nuanced prosodic differences in a large sample of psychopathic offenders with regards to affective expression utilizing recent sophisticated “macroscopic” acoustic analysis technologies, such as the CANS.

The Current Study

Previous studies have highlighted the utility of examining associations between natural speech output and a number of constructs theoretically related to psychopathy, particularly with regards to ‘disturbances’ in both comprehension of affectively-charged content in others and expression of emotion. However, the literature surrounding distinct patterns of vocal communication in psychopathy is limited in several key ways. First and foremost, prior research has failed to consider variance in psychopathic speech as a function of contextual elements related to the speech induction paradigm. The literature has consistently demonstrated that natural speech varies widely and is heavily influenced by contextual variables related to the

paradigm and individual differences (e.g., affective context of the probe, laboratory versus natural environment captured speech, level of arousal, cognitive load; see Cohen, Dinzeo et al., 2015b; Cowen et al., 2018). As such, it is crucial to evaluate ways in which the context of the paradigm or probe used to elicit speech may influence natural speech output across a series of probes within the individual.

Second, past studies have neglected to account for the role of arousal prompted by the speech probe. Previous studies have utilized paradigms addressing retrospective, affectively-charged probes that may induce a high level of arousal in their participants (e.g., prompting inmates convicted of homicide to recount the details of their offense; see Hancock, Woodworth, & Porter, 2013). While such paradigms are successful in priming memories that would theoretically induce affective states, they fail to consider variance from a neutral, baseline speech output or the potential for variance in vocal communication as a function of valence or arousal effects associated with the probe.

Third, the previous literature is limited based on its use of relatively unsophisticated vocal analysis technologies, or use of subjective ratings of prosody, as well as its narrowed focus on variables related to basic speech processes (amplitude and rate of speech). Further, limits related to technologies utilized by prior studies did not permit more detailed examination of prosodic variables within and across speech samples, especially with a larger sample size. For example, technologies utilized by Louth and colleagues (1998) only enabled the authors to examine variations in amplitude in a sample of 10 psychopathic and 10 non-psychopathic offenders. Such technological restrictions may have resulted in limited power to detect significant findings. Finally, no study to date has examined variation in natural speech across variants (subtypes) of psychopathic personality. Given the considerable heterogeneity both in

terms of etiology and phenotypic manifestations of psychopathic personality, an examination of distinctions in natural speech output may provide additional evidence in support of differences in affective expression across psychopathy subtypes.

In light of the aforementioned limitations of previous empirical investigations of the language of psychopaths, the current study provides several critical methodological and theoretical advancements. The present study's use of advanced acoustic analysis technologies represents a novel effort in examining more detailed variation across a series of prosodic variables both within and across an individual offenders' speech samples. Further, acoustic analysis technologies utilized in the current study to examine variance in prosody may provide novel insight to the classic observation of calloused and shallow affect and psychopathy (Hare & Neumann, 2008). Specifically, an evaluation of subtle variance across a range of macroscopic level prosodic variables (e.g., variability in intensity, emphasis, intonation, and speech production) both within and across speech samples may offer greater insight into the nature of "shallow" affective expression in psychopathic speech. Critically, a shift in focus to addressing prosodic analyses on the "macro" level represents a large methodological advantage such that it allows for examination of more stable phenomena in natural speech both within and across multiple speech samples within individuals.

While prior research has studied vocal communication in psychopathy using standardized paradigms in a laboratory setting, the present study provides a novel contribution by examining natural speech output in an offender sample in the context of the standardized clinical PCL-R interview. Moreover, the present study represents a significant methodological advantage to better comprehending the impact of contextual variables on natural speech output. Specifically, the present study examined variance in prosodic output across segments of the clinical interview

designed to elicit both positively and negatively valenced emotional content, across both high and low levels of subjective arousal. Finally, the present study further represents a novel contribution to the field of psycholinguistics more broadly in its examination of variance in speech across variants of manifestations in personality pathology.

The purpose of the current study is twofold. The first aim is to replicate and extend the literature using person-centered analyses (latent profile analysis-LPA) to examine variants of psychopathic personality in a large sample of North American male offenders. The second aim is to explore differential relationships between psychopathy subtypes and "macro" – level prosodic variables (see Table 1 for a list of macro-level variables examined in the present study) across a series of affectively charged probes of different valences and levels of arousal captured in the context of the PCL-R interview in male offenders from a large, full-range sample of psychopathic traits using PCL-R total scores. Based on previous literature and theory, the following hypotheses are offered.

Research Aims and Hypotheses

Hypothesis 1

Consistent with prior literature (Klein Hanevald et al., 2018; Krstic et al., 2017; Mokros et al., 2015), it is expected that a four-class solution will emerge, representing prototypical psychopaths, callous-conning offenders, an externalizing psychopathic subtype, and non-psychopathic offenders.

1a. A prototypical subtype will evidence the highest levels of psychopathic traits across all four facets of the PCL-R.

1b. A callous-conning subtype will evidence greater elevations on the Interpersonal and Affective facets and lower scores on the Lifestyle and Antisocial facets.

1c. An externalizing psychopathic subtype will evidence low scores on the Interpersonal facet, and higher scores on the Lifestyle and Antisocial facets.

1d. A non-psychopathic subtype will not evidence substantial elevations on the PCL-R total score nor at the facet level.

Hypothesis 2

Consistent with previous literature (Louth et al., 1998), it is expected that subtypes with elevations on the Interpersonal and Affective facets (callous-conning and prototypical) will evidence a smaller range of intensity (i.e., amplitude, emphasis, shimmer) and intonation compared to the externalizing psychopathic and non-psychopathic subtypes across affectively-charged PCL-R interview probes.

Research Questions

Given the exploratory nature of the present study, the following research questions are offered.

Research Question 1. Will psychopathic and externalizing subtypes demonstrate differences in speech production (e.g., pause mean, silence percentage, utterance mean, utterance frequency, latency to first utterance) compared to non-psychopathic offenders?

Research Question 2. Will psychopathic and externalizing subtypes demonstrate difference in vowel articulation compared to non-psychopathic offenders?

Research Question 3. Will psychopathic and externalizing subtypes demonstrate differences in fundamental frequency (e.g., F0 Mean, Jitter) compared to non-psychopathic offenders?

Research Question 4. Will the prototypic subtype demonstrate differences in speech production, vowel articulation, and fundamental frequency compared to callous-conning, externalizing, and non-psychopathic subtypes?

CHAPTER 2

METHODS

Design

The present study utilized a person-centered approach to examine prosodic distinctions across psychopathy subtypes. For person-centered analyses, the four facets of the PCL-R (i.e., Interpersonal, Affective, Lifestyle, and Antisocial) were used for classification in a latent profile analysis (LPA) using a sample of offenders from a full range of PCL-R total scores. For validation of the emergent subtypes, the present study utilized a 2 x 2 x 4 mixed effects quasi-experimental design with within-subjects effects—valence (positive, negative valence) and arousal (high, low)—and a between-subjects effect for psychopathy subtype (4 latent classes). Standardized administration of the PCL-R was used in a larger sample from which the present study was drawn, and specific segments of the PCL-R interview served as contextual probes theoretically designed to evoke affectively-charged, autobiographical content. Probes utilized in the current study were selected based on their content relevant to the Affective Norms for English Words (ANEW; Bradley & Lang, 1999) dimensional norms for valence and arousal, and can be found in Table 2. Interview Valence (positive, negative) and Interview Arousal (high, low) elicited by the standardized probes from audio-recorded PCL-R interviews served as the within-subjects variables. Dependent variables examined in the present study were prosodic indices (e.g., variables related to speech production and variability) obtained from digitized samples of speech subjected to CANS protocol. See Table 1 for further information regarding dependent measures.

Participants

The current study utilized data from the Southwest Advanced Neuroimaging Cohort

(SWANC) study, an investigation of brain structure and function among criminal offenders with varying levels of psychopathic traits. There were initially 737 male adult offenders in the New Mexico Prison System available for potential inclusion into the current study. However, the present study involved a sub-sample of 469 male offenders from the larger SWANC study who had intact, audio recorded PCL-R interviews to be utilized for later prosodic analysis. Further information on missing data within the larger SWANC dataset is available in the Data Preparation section. To be eligible for SWANC, offenders had to be between 18 and 60 years of age, fluent in English with reading skills at 4th grade level or higher, IQ score of 70 or higher, and free from any history of seizures, psychotic disorder (self or first degree relative), current alcohol or drug use. The present study investigated prosody in male offenders only, as the generalizability of the psychopathy construct in female offenders continues to be a fluid and open area of research (see Vitale et al., 2007).

In using latent profile analysis (LPA) to determine potential variants, a critical decision on the part of the researcher is whether to use extreme cases within a given sample or decide to use the entire sample for the purpose of analysis (Krstic et al., 2018; Neumann, Vitacco, & Mokros, 2016). Applying this issue to the study of psychopathy variants, an extreme cases approach may be useful in identifying primary psychopathy subtypes (e.g., Mokros et al., 2015), but requires very large samples (N = 1,000) in order to obtain an adequate number of extreme cases. In contrast, the use of an entire sample approach provides researchers with a unique opportunity to identify variants within a wider variety of cases and to conduct 'near neighbor' comparisons, which may be particularly useful for identifying subtypes with different etiological or phenotypic manifestations (Klein-Haneveld et al., 2018; Krstic et al., 2018). Given the utility of entire sample approaches for relatively smaller samples and identifying phenotypic

distinctions, the present study examined prosodic distinctions in offenders representing a full range of PCL-R total scores.

Procedures

The present study utilized digital audio recordings of PCL-R interviews with offenders from the New Mexico correctional system who participated in the larger SWANC study. Trained research assistants (RA's) uploaded each audio-recorded PCL-R interview to the WavePad audio editing software to begin the isolation and splicing process. RA's were instructed to listen to each PCL-R interview and identify segments of speech pertaining to standardized probes of interest posited to elicit affective responses of different valences and arousal levels. The probes of interest relevant to the present study can be found in Table 2.

Segments of interest (i.e., standardized probes within the context of the PCL-R interview) were bookmarked and targeted for isolation upon identification, beginning with the initial utterance of the interviewer (i.e. when the interviewer begins speaking) and ending with the beginning of the subsequent probe, including the latency period between probe-irrelevant follow-up query. After identification, RA's isolated the desired probe and saved it as a separate audio file labeled on the basis of the participant's identification number and the valence and arousal level of the given probe (e.g., 1234_Positive_High; 1234_Negative_Low). RA's were further instructed to maintain the integrity of the original audio sample, and saved the intact original interview as a separate file, labeled using the participant's identification number and phrase "whole" (e.g., 1234_WHOLE).

In order to analyze participant speech, it is critical to ensure that only the subject's voice is included in the recording to be processed. To accomplish this, RA's removed any extraneous *interviewer utterances* (i.e., a segment of speech bounded by the other speaker that begins

exactly when the other individual has stopped talking and ends exactly before the pause preceding the other speaker's utterance), *interviewer tokens* (i.e. short speech that does not count as an utterance, such as "uh-huh", "yeah", or "like"), and *background noise* (e.g., chairs clanging, loud noises in the hall over speech), as well as participant speech relevant to an unstandardized interviewer follow-up probes to the initial query. After splicing out irrelevant speech and background noise, the completed audio files were saved in a password protected external hard-drive. The samples were then analyzed using the CANS protocol on-site at the University of North Texas (UNT). Analyzed audio files and output were finally subjected to statistical analyses.

Measures

Computerized Analysis of Natural Speech (CANS)

The Computerized Analysis of Natural Speech (CANS; Cohen et al., 2009) is an automated protocol designed to assess vocal expression from natural speech. The CANS involves a limited "macroscopic" feature set for use with longer natural speech samples. Its emphasis on "macro" level prosodic features provides more nuanced data of variance both within and across individual speech samples than previously available. The CANS protocol involves extraction of basic vocal properties (i.e., *inflection*, or pitch variability; *amplitude*, or mean volume per frame; *emphasis*, or variability in volume; *intonation*, or subjectively defined pitch; and *vocal output*) approximately every 10 milliseconds using Praat software (Boersma, 2001), which are processed and aggregated by utterance (defined as speech bounded by silence of 150 milliseconds) using R and Excel macros (see Cohen et al., 2009). A limited feature set, reflecting fifteen variables of vocal expression and vocal variability, was defined based on Principal Component Analysis of natural speech recordings from over 1500 young adults and over 300

patients with serious mental illnesses (Cohen et al., 2016). Typical variables utilized in previous studies using CANS protocols (see Cohen et al., 2009; Cohen et al., 2014; Cohen et al., 2015; Cohen et al., 2016) concern aspects of speech production and variability both within and across utterances. Prosodic variables examined in the present study can be found in Table 1.

Psychopathy Checklist – Revised (PCL-R)

The Psychopathy Checklist – Revised (PCL-R; Hare, 2003) is the most widely used measure of psychopathy in research, clinical, and forensic settings around the world (Neumann, Hare, & Johansson, 2013). The PCL-R assesses psychopathic traits using a 20-item clinician rated scale based on a semi-structured interview, extensive file review, and specific scoring criteria. Each item is rated as to the extent that it applies to an individual on a 3-point scale (0 = "the item does not apply", 1 = "the item may apply or applies in some respects/conflicts between interview and file that cannot be resolved in favor of a 0 or 2", or 2 = "the item applies to the individual; a reasonably good match in most essential respects"), with total scores ranging from 0 to 40 (Hare, 2003). PCL-R total scores of 30 or greater are typically used to diagnose psychopathy in both research and clinical settings (Hare, 2003). Recent evidence (Neumann et al., 2007) suggests that the PCL-R conceptualizes the construct as a superordinate psychopathy factor underpinned by four highly correlated, first-order factors (i.e. Interpersonal, Affective, Lifestyle, Antisocial). In the present study, PCL-R factor scores were utilized for classification indices in person-centered analyses. The current edition of the PCL-R (PCL-R, 2nd ed.; Hare, 2003) has demonstrated high reliability for both factor and total scores (Neumann et al., 2012). Further, the internal consistency of the second edition was excellent (α = .87) and the standard error of measurement was 3.0 for total scores (Hare, 2003). In order to provide information regarding the consistency of PCL-R item ratings within facets, mean inter-item correlations (MICs) for each of the four

facets were also conducted. Results indicated that MIC values were well within the acceptable range: Interpersonal (.36), Affective (.29), Lifestyle (.40), and Antisocial (.40).

Data Analysis

A priori power analyses conducted in G*Power indicate that the current study would be sufficiently powered with 500 offenders to reach an effect size of 0.50. However, due to constraints related to the larger SWANC sample and limitations in audio quality, the present study included a sample of 469 offenders, which may had contributed to it being slightly underpowered to detect significant effects. Frequency and percentages were recorded for participants' race, ethnicity, and highest level of education completed. Means and standard deviations were reported for age (in years), total scores for psychopathy (PCL-R), facet domain scores for psychopathy (PCL-R), and IQ, as well as the dependent variables (speech production and speech variability prosodic variables collected by the CANS; see Tables 3 and 4). Data was plotted using a histogram to assess for skewness in the data, as well as evaluate skewness and kurtosis statistics. A preliminary analysis was conducted to evaluate the homogeneity of slopes assumption to determine if the relationships between the covariates and dependent variables differ significantly as a function of the independent variables. Results indicated the homogeneity of slopes assumption was not violated; as such, we proceeded with multivariate analyses.

Analyses were carried out in IBM SPSS statistics version 23 (2015) and Mplus version 8 (Muthén & Muthén, 2017) in four steps. First, latent profile analysis (LPA) was conducted using the four facets of the PCL-R using a full range total score sample of male offenders to determine the optimum numbers of subtypes of psychopathic personality. LPA is a type of latent class analysis based on continuous rather than categorical variables that identifies homogeneous subgroups within a larger sample using maximum likelihood (ML) estimation. Consistent with

previous research, mean scores of the four PCL-R facets were used as indicators for the purpose of LPA approaches in the current study (Klein-Haneveld et al., 2018; Krstic et al., 2018; Mokros et al., 2015).

Second, mixed effects multivariate analysis of variance (MANOVA) was conducted to test main study hypotheses evaluating both group differences in speech production and variability (i.e. identified psychopathy subtypes from LPA analyses), as well as determining variability in prosodic output across affectively-charged context (i.e. positive, negative valence; high and low arousal). Third, for breakdown of significant interactions at the within subtype level, separate mixed effects MANOVA were conducted within each subtype to determine significant two-way interactions at the subtype level. Finally, for breakdown of significant interactions between subtypes, separate mixed effects MANOVA were conducted within each valence and arousal level to uncover the significant interaction effects (i.e., group x valence, group x arousal).

CHAPTER 3

RESULTS

Data Preparation

A total of 737 offenders from the New Mexico prison were assessed on psychopathic personality traits using the Psychopathy Checklist-Revised (PCL-R) through the SWANC Study. A priori power analyses conducted in G*Power indicated that the current study would be sufficiently powered with 500 offenders to reach an effect size of 0.50. Of the 737 offenders in the SWANC dataset, 211 did not have audio-recorded samples of the PCL-R, and were thus deemed ineligible for the present study. An additional 31 offenders' audio files exhibited severe audio distortion (e.g., files corrupted to the extent that vocal patterns did not register within audio processing program), while 26 offenders' interviews did not adhere to the structured sequence of interview probes within the SWANC protocol and were thus deemed ineligible. As such, the final sample utilized for the present study was comprised of 469 total offenders representing a full range of PCL-R total scores.

The first stage of data cleaning involved identifying participants who were missing a substantial amount of data (i.e., missing audio recorded segments for any of the probes of interest). Of the 469 cases which underwent the audio processing procedure, 412 cases had complete data, defined as possessing all four probes of interest (i.e., pos_high, pos_low, neg_high, neg_low). 57 cases were identified as having missing data. Of these cases, 42 were missing only one probe. Eleven cases were identified as missing two probes, and four cases were identified as missing three probes. A variable labeled "missing probe" identifying cases missing audio processing data for at least one probe was created, denoting cases with missing probe data as "1" and those with complete data as "0". Second, responses indicating extreme scores on

prosodic variables were assessed. Examination of the data indicated significant departures from normality across several speech variables and probe conditions. However, examination of Mahalanobis distance indices indicated that the present study was within normal limits with regards to multivariate normality. Given the exploratory nature of the present study and lack of empirical evidence suggesting acceptability of transforming behavioral speech data, transformation of speech variables to achieve normality was not conducted.

Finally, meaningful differences between participants with and without missing audio data on probe conditions were assessed. A series of ANOVA's were conducted comparing age, level of education, IQ, and speech variability and production variables between participants with and without missing audio data on probe conditions, as well as for participants with and without available audio data. ANOVA's revealed that there were no significant differences between cases with and without missing audio data or for participants with or without available audio to be included in the larger study, indicating that the data were missing at random. Therefore, all cases with missing data in one probe, but available data for the probes of interest in analyses were included in each subsequent analysis.

Descriptive Statistics for the Overall Sample

The overall sample's PCL-R total score ranged from 3.2 to 37 (M = 20.75, SD = 6.55). Descriptive statistics at the PCL-R total score and facet level, as well as demographic variables can be found in Table 3. Descriptive statistics for all variables of interest related to prosodic output for the overall sample across all probe conditions are presented in Table 4.

Person-Centered (LPA) Results

Latent profile analysis (LPA) was conducted using a full range of PCL-R total scores to determine the optimum numbers of subtypes with varying degrees of psychopathic personality

propensities in a sample of male offenders. LPA is a type of latent class analysis based on continuous rather than categorical variables that identifies homogeneous subgroups within a larger sample using maximum likelihood (ML) estimation. Consistent with previous research, mean scores of the four PCL-R facets were used as indicators to determine the optimal number of latent classes in the current sample (Klein-Haneveld et al., 2018; Krstic et al., 2018; Mokros et al., 2015).

LPA model fit results can be found in Table 5. LPA analyses indicated that the four-class solution yielded the best model fit for the allocation of individual cases to subtypes (BIC = 2111.44; Adjusted BIC = 2038.44; AIC = 2015.98), with high classification accuracy (0.77 – 0.88). In the four-class solution, average probabilities for most likely latent class membership were 0.77, 0.88, 0.85, and 0.88, respectively. The five-class solution did not significantly improve model fit, as evidenced by an improvement in BIC of less than 1. Given evidence suggesting reductions in BIC less than 3 are negligible in terms of improving model fit (Kass & Raftery, 1995), the four-class solution was determined to optimally fit the present data. However, contrary to expectations, one of the four identified psychopathic trait subtype profiles did not conform with the four previously identified subtypes in studies using a full-range approach to PCL-R (Klein Haneveld et al., 2018; Krstic et al., 2018; Mokros et al., 2015). Specifically, the results did not reveal evidence for a callous-conning subtype, though this is perhaps not surprising given this subtype profile has been found to represent the smallest proportion of offenders with psychopathic features (Neumann et al., 2016). For the current results, the four subtypes uncovered were as follows: LC1 (non-psychopathic general offenders; n = 83), LC2 (moderate externalizing offenders; n = 222), LC3 (severe externalizing offenders; n = 124), and LC4 (prototypical psychopaths; n = 40). For descriptive purposes, means and standard deviations

for PCL-R total scores within each group are provided: non-psychopathic offenders (M = 11.47; SD = 3.23), moderate externalizing offenders (M = 20.01; SD = 3.75), severe externalizing offenders (M = 25.14; SD = 4.06), and prototypical psychopathic offenders (M = 30.53; SD = 3.88). Table 6 and Figure 1 display the mean total and facet scores of the PCL-R within each subtype.

For descriptive purposes, the subtypes were examined in terms of PCL-R score differences. Larger effects sizes for class separation adds to the validity of the LPA solution. Significant subtype effects emerged for the PCL-R total score (F (3, 465) = 317.61; $p < .001$; partial η^2 = .67), with post-hoc analyses revealing all identified subtypes significantly differed from each other at the p < .001 level. Similarly, significant subtype effects emerged for each of the four PCL-R facets: Interpersonal (F (3, 465) = 745.85; $p < .001$; partial η^2 = .83), Affective, (F (3, 465) = 46.13; $p < .001$; partial η^2 = .23), Lifestyle (F (3, 465) = 90.91; $p < .001$; partial η^2 = .37), and Antisocial (F (3, 465) = 103.97; $p < .001$; partial η^2 = .40). Consistent with results from analyses utilizing PCL-R total score, post-hoc analyses revealed that all subtypes significantly differed from each other at the $p < .001$ level for each facet score. These results are expected since PCL-R facet scores were used for the LPA classification, but nevertheless highlight that there was good separation of the subtypes which provides confidence in the verisimilitude of the results (Tein et al., 2013).

Demographics for the Overall Sample and Within Latent Classes

The age of all participants ranged from 17 to 60 (M = 34.18, SD = 9.31). One-way ANOVA indicated a slight difference in age across the latent classes (F (3, 465) = 5.38; p = .001; Partial η^2 = .003). Post-hoc analyses indicated that offenders within non-psychopathic offenders (M = 37.42; SD = 10.27) were significantly older than offenders in moderate externalizing

offenders (*M* = 32.93; *SD* = 8.92; *p* = .003) or severe externalizing offenders (*M* = 33.70; *SD* = 9.19; *p* = .04). Prototypical offenders (M = 35.85; SD = 8.13) did not significantly differ from moderate or severe externalizing subtypes or non-psychopathic offenders in terms of age. It is important to note that results of correlational analyses indicated weak to non-significant relationships between age and both prosodic and PCL-R variables. Furthermore, the observed effect size of differences in age across subtypes was particularly small.

With regards to race, the overall sample was primarily Caucasian (79.3%), followed by Black (10.6%), American Indian/Alaska Native (8.2%), Asian/Pacific Islander (1.5%), and Biracial (0.4%). Chi-square analyses did not reveal statistically significant differences across identified latent classes in terms of race (χ^2 [6] = 14.74; *p* = .19).

With regards to ethnicity, the overall sample was predominately Hispanic/Latino (57.1%), followed by non-Hispanic/Latino (42.9%). Chi-square indicated statistically significant differences in ethnicity proportions between latent classes (χ^2 [3] = 15.62; *p* = .001). 44.57% of non-psychopathic offenders, 62.1% of moderate externalizing offenders, 62.9% of severe externalizing offenders, and 39.5% of prototypical psychopathic offenders identified as Hispanic/Latino. Due to these observed differences, a four-way mixed effects MANOVA (latent class x Hispanic/Latino status x valence x arousal) was conducted to check on the potential impact of ethnicity on prosodic outcomes. Results of MANOVA analyses indicated there were no significant interactions between subtype, ethnicity, or prosodic variables, and in particular, the four-way interaction was non-significant. As such, it was decided to proceed with analyses at the three-way level for the purpose of main study hypotheses examining variance in prosody as a function of subtype.

Concerning the overall sample's level of education, total years of education ranged from

5 to 20 (*M* = 9.68, *SD* = 3.70). Results of one-way ANOVA indicated a significant difference across latent classes in terms of years of education attained (F (3, 465) = 7.20; $p < .001$; Partial $\eta^2 = .002$). Post-hoc analyses revealed that non-psychopathic offenders (*M* = 10.42; *SD* = 3.64) had significantly more years of education than the moderate externalizing offenders (*M* = 9.11; *SD* = 3.40; *p* = .03). Further, prototypical psychopathic offenders (*M* = 11.76; *SD* = 4.38) were found to have significantly more years of education than moderate (*p* = .004) or severe externalizing offenders (*M* = 9.54; *SD* = 3.76; *p* = .03). It is important to note that results of correlational analyses indicated weak to non-significant relationships between level of education and both prosodic and PCL-R variables. Furthermore, the observed effect size of differences in level of education across subtypes was particularly small.

The overall sample's FSIQ as measured by the WASI-II (Wechsler, 2011) ranged from 72 to 137 (*M* = 97.54, *SD* = 13.65). Results of ANOVA did not indicate meaningful differences between latent classes on the basis on FSIQ.

Mixed-Effects MANOVA

Three factor mixed MANOVAs (4 group x 2 valence x 2 arousal) were conducted to evaluate differences in speech production and variability measures generated by the CANS between offender subtypes (i.e., non-psychopathic offenders, moderate externalizing offenders, severe externalizing offenders, and prototypical psychopathic offenders) within probes that differed on the basis of valence (i.e., positive, negative) and arousal (i.e., high, low). Planned contrasts were included with each MANOVA to aid in differentiating subtypes within a given level of the within-subjects factors, with differences reported in terms of t-test significance for these planned parameters. Results for MANOVA analyses can be found in Table 7. No significant two-way interaction effects were found on the basis of group x valence. However,

significant two-way interactions were found for valence x arousal, which are shown in Table 7. In general, significant valence x arousal interactions provided support for the study methodology—i.e., capturing speech prosody for specific questions of the PCL-R interview with respect to valence and arousal. Also, multivariate group x arousal interactions were revealed that trended towards significance. Finally, consistent with study hypotheses, significant three-way interactions were also found (e.g., group x valence x arousal; see Table 7), which will be interpreted in the following sections along with results of interaction breakdown analyses. It is important to note that given the exploratory nature of the present study, corrections for statistical significance (e.g., Bonferroni) were not conducted.

Significant Three-Way (Group x Valence x Arousal) MANOVA Interactions

Recording Length

Length of the recording demonstrated a significant three-way interaction (F (3, 466) = 3.19; p = .02; Partial η^2 = .02). Examination of the pattern of differences across Figures 2 and 3 facilitated the interpretation of significant 3-way interactions with regards to length of the recording. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. The MANOVA results revealed significant two-way interactions only for non-psychopathic offenders (F (1, 83) = 10.58; p = .002) and prototypical psychopathic offenders (F (1, 39) = 6.15; p = .02). These results suggest moderate externalizing and severe externalizing offenders show relatively little change in recording length across both valence and arousal conditions, whereas the non-psychopathic and prototypic subtypes provided longer recordings when moving from low to high arousal, particularly negative valence questions. Next,

separate paired-samples t-tests were conducted within and across the respective valence and arousal levels to further breakdown significant two-way interactions.

Looking across arousal levels, the results indicated that non-psychopathic offenders exhibited significantly longer recording lengths for positively (t (82) = 1.99; p = .05) and negatively (t (82) = 4.90; p < .001) valenced conditions in the high versus low arousal levels. Specifically, within the positive valence conditions, subtype x arousal interactions (Figure 3) indicated non-psychopathic offenders provided longer recording lengths in the high arousal condition. Within the negative valence conditions, non-psychopathic offenders produced longer recording length in the high arousal condition. Further, non-psychopathic offenders evidenced significant differences in both high (t (82) = -4.58; p < .001) and low (t (82) = -1.80; p = .07) arousal conditions across valence conditions. Specifically, within the high arousal conditions, subtype x valence interactions (Figure 2) indicated non-psychopathic offenders evidenced longer recording lengths in the negatively valence condition. Within the low arousal conditions, non-psychopathic offenders evidenced longer recording lengths in the negatively valenced condition compared to positively valenced condition.

Results for the prototypical psychopath subtype indicated statistically significant differences on the basis of negatively (t (39) = 3.04; p = .004), but not positively valenced conditions in the high versus low arousal levels. Specifically, within the negatively valenced condition, prototypical psychopaths produced longer recording lengths in high, as compared to low levels of arousal. Further, prototypical psychopathic offenders evidenced significant differences in high (t (39) = -3.02; p = .004), but not low arousal conditions. Within high arousal conditions, prototypical psychopaths produced longer recording lengths in the negative, as compared to positive valenced condition.

To aid in interpretation of significant 3-way interactions at the between groups level, separate mixed effects MANOVA were conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence & latent class x arousal) interactions. Results indicated a significant interaction in low arousal across valence levels (F (3, 465) = 5.43; $p < .001$; Partial $\eta^2 = .03$). Looking across subtypes, results indicated that non-psychopathic offenders produced significantly shorter recording lengths than prototypical psychopathic offenders ($t = 5.42$; $p < .001$) in low arousal conditions across valence types (Figure 3). MANOVA results further demonstrated a significant interaction in negative valence across arousal levels (F (3, 465) = 2.76; $p = .04$; Partial $\eta^2 = .02$). Results across subtypes indicated that non-psychopathic offenders producted significantly shorter recordings than the offenders in moderate externalizing ($t = -1.80$; $p = .05$) or prototypical psychopath ($t = 2.41$; $p = .02$) groups. Further, prototypical psychopaths exhibited longer recording lengths than moderate externalizing offenders in negatively valenced conditions across levels of arousal ($t = -4.80$; $p = .002$). No significant interactions were found at the MANOVA level for high arousal across valence or positive valence across arousal conditions across subtypes.

Silence Percent

Percentage of silence within the speech sample demonstrated a significant three-way interaction (F (3, 466) = 2.59; $p = .05$; Partial $\eta^2 = .02$). Examination of the pattern of differences across Figures 4 and 5 facilitated the interpretation of significant 3-way interactions with regards to percentage of silence within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 15.53; $p <$

.001) and severe externalizing offenders (F (1, 123) = 4.83; p = .03). The results demonstrated that offenders in the moderate and severe externalizing groups showed significantly more silence as a function of valence and arousal. As seen in Figures 4 and 5, externalizing offenders demonstrated a tendency to become more silent when moving from high to low arousal during negatively valenced probes. Non-psychopathic and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.56; p < .001), but not positively valenced condition in high versus low arousal levels. Specifically, within negatively valenced conditions (Figure 5), moderate externalizing offenders produced greater percentages of silence within the high as compared to low condition. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -3.72; p < .001) and low (t (221) = 2.02; p = .05) arousal conditions across valence conditions. Specifically, within high arousal conditions (Figure 4), moderate externalizing offenders produced greater percentages of silence within the negative as compared to positive valence conditions. Within low arousal conditions, moderate externalizing offenders evidenced greater silence within the positively compared to negatively valenced condition.

Results for severe externalizing offenders indicated statistically significant differences on the basis of negatively (t (123) = 1.90; p = .06), but not positively valenced conditions in high versus low arousal levels. Specifically, within negative valenced conditions (Figure 5), severe externalizing offenders produced greater silence within the high compared to low arousal

condition. Further, severe externalizing offenders evidenced significant differences in high (t (123) = -1.67; p = .09), but not low arousal conditions across valence conditions. Within high arousal conditions (Figure 4), severe externalizing offenders showed greater silence percentages in the negative compared to positively valenced condition.

Separate mixed effects MANOVA were then conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal) interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.57; p = .01; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders produced significantly more silence within a speech sample than offenders in moderate (t = 2.74; p = .01) or severe externalizing (t = -2.06; p = .04) groups. No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

Utterance Frequency

Number of utterances within the speech sample demonstrated a significant three-way interaction (F (3, 466) = 2.46; p = .06; Partial η^2 = .02). Examination of the pattern of differences across Figures 6 and 7 facilitated the interpretation of significant 3-way interactions with regards to frequency of utterances within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions at the within-group level. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 16.40; p < .001) and severe externalizing offenders (F (1, 123) = 4.78; p = .03). Non-psychopathic offenders and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the

basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.87; $p < .001$), but not positively valenced condition in the high versus low arousal levels. Specifically, within negatively valenced probe conditions (Figure 7), moderate externalizing offenders exhibited greater utterances in the high compared to low arousal prompt. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -4.06; $p < .001$) and low (t (221) = -1.81; $p = .07$) arousal conditions across affective valence. Specifically, within the high arousal conditions (Figure 6), moderate externalizing offenders issued more utterances in the negative compared to positive valence condition. However, within the low arousal conditions, offenders within the moderate externalizing subtype produced more utterances in the positively compared to negatively valenced condition.

Results for severe externalizing offenders indicated statistically significant differences on the basis of negatively (t (123) = 1.97; $p = .05$), but not positively valenced conditions in the high versus low arousal levels. Specifically, within the negatively valenced conditions (Figure 7), severe externalizing offenders produced more utterances in the high compared to low arousal condition. Further, offenders within the severe externalizing subtype evidenced significant differences in high (t (123) = -1.96; $p = .05$), but not low arousal conditions across valence. Within the high arousal condition (Figure 6), offenders in the severe externalizing subtype produced more utterances in the negatively as compared to positively valenced condition.

Separate mixed effects MANOVA were then conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal)

interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.33; p = .02; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders produced significantly fewer utterances within a speech sample than offenders in moderate (t = 2.53; p = .01) or severe externalizing (t = -2.09; p = .03) groups. No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

F0 Mean

The average rate of fundamental frequency within a given speech sample demonstrated a significant three-way interaction (F (3, 466) = 2.50; p = .05; Partial η^2 = .02). Examination of the pattern of differences across Figures 8 and 9 facilitated the interpretation of significant 3-way interactions with regards to average fundamental frequency (i.e., F0 mean) within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 14.23; p < .001) and severe externalizing offenders (F (1, 123) = 6.14; p = .01). Non-psychopathic offenders and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.39; p < .001), but not positively valenced condition in the high versus low arousal levels. Specifically, within negative valence conditions (Figure 9), moderate externalizing offenders evidenced larger average F0 values in

the high compared to low arousal condition. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -3.37; p = .001) and low (t (221) = -2.12; p = .04) arousal conditions across affective valence levels. Specifically, within high arousal conditions (Figure 8), offenders within the moderate externalizing subtype produced larger average F0 values in the negative as compared to positive valence levels. However, within low arousal conditions, moderate externalizing offenders evidenced larger average F0 scores in the positively as compared to negatively valenced condition.

Results for severe externalizing offenders did not indicate statistically significant differences on the basis of either negatively or positively valenced conditions in the high versus low arousal levels. However, severe externalizing offenders evidenced significant differences in low (t (123) = 2.14; p = .03), but not high arousal conditions across valence conditions (Figure 8). Specifically, within low arousal conditions, severe externalizing offenders evidenced larger average F0 scores in the positively as compared to negatively valenced condition.

Separate mixed effects MANOVA were finally conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal) interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.85; p = .01; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders produced significantly larger average F0 values than offenders in moderate (t = 2.84; p = .004) or severe externalizing (t = -2.16; p = .03) groups. No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

Jitter

Jitter further demonstrated a significant three-way interaction (F (3, 466) = 2.49; p = .05;

Partial η^2 = .02). Examination of the pattern of differences across Figures 10 and 11 facilitated the interpretation of significant 3-way interactions with regards to jitter (i.e., average rate of change in fundamental frequency) within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 14.25; $p < .001$) and severe externalizing offenders (F (1, 123) = 6.16; $p = .01$). Non-psychopathic offenders and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.40; $p < .001$), but not positively valenced condition in the high versus low arousal levels. Specifically, within the negative conditions (Figure 11), moderate externalizing offenders produced greater jitter in the high as compared to low level of arousal condition. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -3.38; $p = .001$) and low (t (221) = 2.12; $p = .04$) arousal conditions across affective valence. Within high arousal conditions (Figure 10), offenders in the moderate externalizing subtype exhibited greater jitter in the negatively compared to positively valenced condition. However, within low levels of arousal, moderate externalizing offenders evidenced greater jitter in the positive compared to negative condition.

Results for severe externalizing offenders did indicated statistically significant differences on the basis of either negatively or positively valenced conditions in the high versus low arousal levels. However, severe externalizing offenders evidenced significant differences in

low (t (123) = 2.15; p = .03), but not high arousal conditions across valence conditions. Specifically, within low levels of arousal (Figure 10), severe externalizing offenders produced greater jitter in the positive compared to negative condition.

Separate mixed effects MANOVA were then conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal) interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.85; p = .01; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders produced significantly greater jitter within speech samples than offenders in moderate (t = 2.84; p = .004) or severe externalizing (t = -2.17; p = .03) groups. No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

Amplitude

The average volume of a given speech sample demonstrated a significant three-way interaction (F (3, 466) = 2.48; p = .06; Partial η^2 = .02). Examination of the pattern of differences across Figures 12 and 13 facilitated the interpretation of significant 3-way interactions with regards to amplitude (i.e., average volume) within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 14.22; p < .001) and severe externalizing offenders (F (1, 123) = 5.61; p = .02). Non-psychopathic offenders and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.43; $p < .001$), but not positively valenced condition in the high versus low arousal levels. Specifically, within the negatively valenced conditions (Figure 13), moderate externalizing offenders spoke at a louder average volume in the high as compared to low arousal condition. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -3.39; p = .001) and low (t (221) = 2.10; p = .04) arousal conditions across valence conditions. Specifically, within high arousal levels (Figure 12), moderate externalizing offenders spoke at a louder average volume in the negative compared to positive condition. However, within low levels of arousal, offenders in the moderate externalizing subtype spoke at a louder volume in the positively compared to negatively valenced condition.

Results for offenders within the severe externalizing subtype did not indicate statistically significant differences on the basis of either negatively or positively valenced conditions in the high versus low arousal levels. However, severe externalizing offenders evidenced significant differences in low (t (123) = 1.98; p = .05), but not high arousal conditions across affective valence. Within low levels of arousal (Figure 12), offenders in the severe externalizing subtype spoke at a louder volume in the positively compared to negatively valenced condition.

Separate mixed effects MANOVA were then conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal) interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.95; p = .01; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders spoke at a louder average volume than offenders in moderate (t = 2.82; p = .01) or severe externalizing (t = -2.23; p = .02) groups. Further, moderate externalizing

offenders spoke at a louder average volume than those in the severe externalizing subtype in negatively valenced conditions across levels of arousal (t = 1.98; p = .05). No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

Shimmer

Shimmer demonstrated a significant three-way interaction (F (3, 466) = 2.47; p = .06; Partial η^2 = .02). Examination of the pattern of differences across Figures 14 and 15 facilitated the interpretation of significant 3-way interactions with regards to amplitude (i.e., average volume) within the speech sample. To aid in interpretation of significant 3-way interactions, separate mixed effects MANOVA were conducted within each subtype to evaluate for significant two-way (valence x arousal) interactions. Results of these MANOVA revealed significant two-way interactions within moderate externalizing offenders (F (1, 221) = 14.25; p < .001) and severe externalizing offenders (F (1, 123) = 5.60; p = .02). Non-psychopathic offenders and prototypical psychopathic offenders did not show significant two-way interactions. Next, separate paired-samples t-tests were conducted on the basis of valence and arousal to further breakdown significant two-way interactions uncovered within subtypes.

Looking across arousal levels, the results indicated that moderate externalizing offenders exhibited significant differences in the negatively (t (221) = 4.40; p < .001), but not positively valenced condition in the high versus low arousal levels. Specifically, within the negative valence conditions (Figure 15), moderate externalizing offenders produced greater shimmer in the high compared to low condition. Further, moderate externalizing offenders evidenced significant differences in both high (t (221) = -3.37; p = .001) and low (t (221) = 2.12; p = .03) arousal conditions across affective valence. Within high arousal probes (Figure 14), moderate

externalizing offenders produced greater shimmer in the negatively as compared to positively valenced conditions. However, within low arousal conditions, offenders in the moderate externalizing subtype exhibited greater shimmer in the positive compared to negative condition.

Results for severe externalizing offenders indicated statistically significant differences in the positively (t (123) = -1.84; p = .06), but not negatively valenced condition in the high versus low arousal levels. Specifically, within the positive conditions (Figure 15), severe externalizing offenders produced greater shimmer in the low as compared to high arousal condition. Further, severe externalizing offenders evidenced significant differences in low (t (123) = 1.98; p = .05), but not high arousal conditions across valence conditions. Within low arousal conditions (Figure 14), severe externalizing offenders exhibited greater shimmer in the positive as compared to negative probe condition.

Separate mixed effects MANOVA were then conducted within each valence and arousal level to evaluate for significant two-way (i.e., latent class x valence, latent class x arousal) interactions. Results indicated a significant interaction in negative valence across arousal levels (F (3, 465) = 3.94; p = .01; Partial η^2 = .02). Results across subtypes indicated that non-psychopathic offenders spoke with greater variation in volume throughout the speech sample than offenders in moderate (t = 2.81; p = .01) or severe externalizing (t = -2.24; p = .03) groups. No significant interactions were found at the MANOVA level for high or low arousal levels across valence or positive valence across arousal conditions across subtypes.

CHAPTER 4

DISCUSSION

Psychopathy is a clinical construct that represents a considerable cost to both the criminal justice system and society at large (Kiehl & Hoffman, 2011). Given robust evidence implicating psychopathic personality traits as important predictors of violence and criminal recidivism (Hare & Neumann, 2008; Olver et al., 2018), the use of reliable and valid assessments of psychopathy represents a critical endeavor in better understanding this construct and relevant external correlates. Studies utilizing well-validated and reliable measures of psychopathy, such as the PCL-R (Hare, 2003), have found evidence of considerable systematic heterogeneity among offenders with psychopathic traits (Decuyper et al., 2013; Hicks et al., 2010; Krstic et al., 2018; Mokros et al., 2015). Such evidence highlights the importance of research utilizing person-centered analyses, such as latent profile analysis (LPA), which allow for the identification of potential subtypes of psychopathy represented by distinct trait profiles. The identification and validation of subtypes of psychopathy through use of person-centered analyses enables researchers to use a more nuanced exploration of the links between relevant external correlates and psychopathic trait profiles. Prosody is an external correlate that may provide novel insight into phenotypical distinctions related to underlying cognitive and affective processes across psychopathy subtypes, as it contains a wealth of information relevant to understanding psychological functioning (e.g., disruptions in cognition and affect; Cohen, Dinzeo et al., 2016; Cohen et al., 2009).

Although there has been limited research considering differences in prosody and other linguistic indices in offenders with psychopathy (de Almeida Brites et al., 2015; De Almeida Brites, 2016; Hancock et al., 2013; Louth et al., 1998), the current study provides several novel

contributions to our understanding of psychopathic speech. First, prosodic output was examined within the context of a clinical interview (i.e., the PCL-R) rather than through a pure laboratory paradigm, thus facilitating a more "natural" examination of natural speech. Further, the current study provides a novel contribution to the literature regarding psychopathic speech by including multiple probe conditions to address variance in prosodic output as a function of both valence and arousal-level of the emotion-induction stimuli.

A robust body of evidence indicates natural speech is heavily influenced by contextual variables related to both the paradigm and individual differences (e.g., affective context of the probe, laboratory versus natural environment captured speech, level of arousal, cognitive load; see Cohen, Dinzeo et al., 2015b; Cowen et al., 2018). As such, the present study offers a novel examination of contextual elements related to the paradigm of interest within the context of interpersonal interaction through a clinical interview rather than a pure laboratory sample, as well as within the context of differing affective states. Second, the current study's use of advanced, macro-level acoustic analysis technologies represents a considerable methodological advantage, thus facilitating examination of more nuanced, global prosodic indices than available in previous studies (de Almeida Brites et al., 2015; de Almeida Brites, 2016; Louth et al., 1998). Finally, the present study further represents a novel contribution to the field of psycholinguistics as a whole in its examination of differences in prosodic output across subtypes of personality pathology.

The current study aimed to replicate and extend the literature using person-centered analyses (i.e., latent profile analysis; LPA) to examine variants of psychopathic personality in a large sample of North American male offenders. Moreover, the current study aimed to explore differential relationships between subtypes of psychopathy and "macro" – level prosodic

variables across a series of affectively charged probes of different valences and levels of arousal captured in the context of the PCL-R interview. Finally, the present study examined variable-centered relationships between psychopathic trait domains and prosodic variables through use of correlational analyses within a full-range sample of PCL-R total scores.

Person-Centered Analyses

As anticipated, LPA results indicated that the four-class solution had the best overall model fit. These findings are consistent with those from other studies utilizing large offender samples and a full-range approach to PCL-R total scores (Krstic et al., 2018; Klein-Haneveld et al., 2018, Neumann et al., 2016; Mokros et al., 2015). However, our findings regarding specific trait profiles contradicted main study hypotheses in that all identified subtypes did not conform to subtypes described in the literature. Specifically, consistent with previous research, a prototypical psychopathic class (LC1) emerged, which was characterized by elevations across all four psychopathic trait domains. Results further support the distinction of a moderate externalizing offenders (LC2), which is consistent with previous findings of sociopathic classes (Krstic et al., 2018; Klein-Haneveld et al., 2018, Neumann et al., 2016; Mokros et al., 2015) and was characterized by greater elevations in the Lifestyle and Antisocial facets, and relatively lower elevations on the Interpersonal and Affective facets. Inconsistent with findings of previous studies, a severe externalizing offender (LC3) additionally arose, with greater elevations in Interpersonal and Affective trait domains than the other latent classes, with the exception of the prototypical class, as well as substantial elevations in both Lifestyle and Antisocial trait domains. Finally, consistent with previous literature, a non-psychopathic offender class (non-psychopathic offenders) emerged without substantial elevations across psychopathic trait domains.

The observed consistency in the prototypical psychopathic, moderate externalizing (i.e.,

"sociopathic"), and non-psychopathic offender subtypes within the current study with those previously identified in the literature through studies using LPA with a full range approach to PCL-R total score (e.g., Krstic et al., 2018; Klein-Haneveld et al., 2018; Neumann, Vitacco et al., 2016) contributes to efforts to empirically identify meaningful subtypes of psychopathic personality within offender populations. The emergence of the severe externalizing subtype, while unexpected, may be interpreted with regards to the present study including a large Hispanic/Latino sample. Specifically, evidence suggests that Antisocial trait domains are often more prominently elevated within Hispanic/Latino populations (Eisenbarth et al., 2018; Gatner et al., 2018). As such, the significant elevation in Antisociality observed within the severe externalizing subtype may be related to sample differences within the present study, specifically one which contained a much higher proportion of Latino offenders than previous research. The results of the present study also provide further evidence for the utility of person-centered analyses in the study of psychopathy specifically, as well as psychopathology more broadly, for ascertaining relationships between a disorder and its theoretically relevant external correlates at the within-person level.

External Validation of Psychopathy Subtypes

In light of findings supporting the emergence of theoretically-relevant psychopathic subtypes, attempts were made to ascertain their potential differential associations with prosodic outcomes through use of mixed effects MANOVA. As anticipated, MANOVA results revealed significant three-way interactions, suggesting that offenders within distinct psychopathic subtypes differed meaningfully in their prosodic output as a function of both affective valence and arousal level of a given probe. In addition, results indicating significant interaction effects of valence and arousal provide further support both for the emotion-induction stimuli utilized in the

present study and the utility of multiple probe conditions reflecting distinct affective contexts in the study of natural speech output. Given the complexity of interactions observed in the current study, the following discussion will focus on observed distinctions at the latent-class level in terms of prosodic output in both speech production and variability indices.

Distinctions in Speech Production across Latent Classes

Results indicated that across affective valence and arousal, non-psychopathic offenders exhibited distinctions in prosodic output relevant to speech production, including both a greater percentage of silence and fewer utterances than moderate or severe externalizing offenders. Further, within negatively valenced probes across arousal conditions, non-psychopathic offenders produced shorter recording lengths than moderate externalizing or prototypical psychopathic offenders. Such findings suggest that for non-psychopathic offenders, verbal responses to negatively valenced probes regardless of level of arousal, such as inquiring as to moments of intense sadness or anger from one's personal history, may invoke greater cognitive load (Cohen et al., 2015) and contribute to observed increases in verbal disfluency. Interestingly, supplemental analyses revealed that non-psychopathic offenders also had significantly longer, longest pause lengths than offenders in all three remaining classes across all probe conditions. These results may reflect the reduced availability and difficulty to recall affectively-valenced information, or conversely, the greater accessability of affectively-valenced content within the other offender classes.

Taken together, these results indicate that affective valence, particularly negatively-valence content within a low-level of arousal, may have a greater impact on non-psychopathic offenders' speech production relative to those within the externalizing and psychopathic classes. It is important to note that the negative valence, low arousal condition directly queried offenders

about the saddest moment in their autobiographical history. With consideration to the contextual elements relevant to the probe, these findings may also be interpreted with regards to research suggesting negative affect and autobiographical content relevant to moments of depression are associated with diminished speech production (Cummins et al., 2015).

Across valence and arousal conditions, both moderate and severe externalizing offenders offenders evidenced shorter overall recording lengths, smaller percentages of silence, and greater utterances than non-psychopathic offenders. However, moderate externalizing offenders exhibited shorter recording lengths within negatively valenced conditions across levels of arousal than offenders in the prototypical psychopath class. Evidence from analyses at the within group level further suggested that both moderate and severe externalizing offenders exhibited a similar pattern in which they become more dysfluent (i.e., greater percentages of silence, fewer utterances, shorter recording lengths) when presented with negatively as compared to positively valenced affective content. Supplemental analyses further revealed that moderate externalizing offenders demonstrated longer longest pause lengths than prototypical psychopaths within the negatively valenced conditions across levels of arousal. These results may highlight the impact of cognitive load when presented with affective information on moderate externalizing offenders. As such, it is possible that the observed shorter overall recording lengths may be reflective of greater difficulty generating exemplars of affective content from moderate externalizing offenders' autobiographical history when compared to offenders within the prototypical psychopathic, but increased fluency when compared to non-psychopathic offenders.

Taken together, the findings of the present study suggest that although moderate externalizing offenders may be more fluent in terms of speech production than non-psychopathic offenders, they are less verbally facile than offenders within the prototypic psychopathic class

characterized by more pronounced elevations in the Interpersonal and Affective trait domains. Such a finding is consistent with both theoretical and empirical evidence suggesting that externalizing psychopathy (i.e., consistent with the traditional “secondary psychopath” or “sociopath”) is associated with greater affective and behavioral instability, as well as higher levels of negative affect and trait anxiety than seen in variants of primary psychopathy (Hicks et al., 2010; Mokros et al., 2015; Olver et al., 2015; Poythress et al., 2010). Further support can be found in the observed similarities across the moderate and severe externalizing subtypes in terms of patterns of speech production both within and across groups. In this context, these noted differences in presence of negative affect among certain subtypes of psychopathy may influence fluency in terms of speech production when present with negatively valence probes. Such a finding may be explained by the observed associations between negative affect and Lifestyle and Antisocial features of psychopathy.

Results indicated that offenders within the prototypical psychopath class exhibited longer recordings than either moderate externalizing or non-psychopathic offenders. Further, supplementary analyses revealth that prototypical psychopaths produced shorter longest pause lengths than offenders in any of the three remaining classes across all levels of valence and arousal. Such findings suggest that prototypical psychopathic offenders are, in general, more fluid with regards to their speech production when presented with affectively-charged probes. Furthermore, findings regarding greater fluidity in speech when discussing affectively ladened autobiographival content within prototypical psychopaths could reflect greater confidence and persuasive ability. Interpretation of these findings at the multivariate interaction level can be facilitated by results of MANOVA analyses at the within group level. These results suggest that prototypical psychopathic offenders were less impacted by valence or arousal of a probe and

exhibited more consistent speech production than externalizing subtypes characterized by more pronounced elevations in Lifestyle and Antisocial trait domains. As such, high level elevations in traditional Factor 1 psychopathic trait domains may possibly facilitate fluidity of speech output as a means of interpersonal manipulation for prototypical psychopathic offenders.

Alternatively, findings related to prototypical psychopaths being less impacted by affective valence or arousal in terms of speech production may be interpreted with regards to literature suggesting that variants of primary psychopathy characterized by greater elevations in Interpersonal and Affective trait domains evidence relatively less affective and behavioral instability than other psychopathy subtypes (Hicks et al., 2010; Olver et al., 2015). As such, it may be that prototypical psychopathic offenders experience relatively less affective arousal and may be less impacted by cognitive load as a function of high levels of traditional Factor 1 traits, and are thus more verbally facile than offenders with greater elevations in Factor 2 trait domains. Evidence for this proposition may be found in findings of the current study suggest that offenders within the moderate and severe externalizing class were more fluent in terms of speech production relative to non-psychopathic offenders, but less fluent than offenders within the prototypical psychopathy class and more impacted at the within subtype level by the impact of negative valence on fluency. However, it is important to note that while prototypical psychopathic offenders were more fluent in terms of speech production, results of indices of speech variability (e.g., F0 mean, jitter, amplitude) exhibited disruptions in prosodic output under different valence and arousal conditions.

Distinctions in Speech Variability across Latent Classes

Results further suggested distinctions in non-psychopathic offenders' prosodic output with regards to speech variability across negatively valenced conditions elicitly different levels of

arousal. When compared moderate and severe externalizing offenders offenders, non-psychopathic offender's speech output was characterized by significantly larger *average fundamental frequency* (F0; i.e., average rate of subjectively defined pitch), greater *jitter* (i.e., average rate of change in subjectively defined pitch throughout a given sample), greater *amplitude* (i.e., louder average volume), and greater *shimmer* (i.e., variation in volume throughout speech sample). As such, it would appear that non-psychopathic offenders evidenced greater variation in natural speech output when asked to recall negatively valenced autobiographical memories, which may be reflective of greater affective arousal in the aforementioned probe condition relative to moderate and severe externalizing offenders.

However, it is important to note that findings at the within subtype level suggest a similar pattern of increased variability (i.e., larger average fundamental frequency, louder average volume, greater variation in volume throughout the speech sample) for both moderate and severe externalizing offenders. Specifically, offenders within externalizing subtypes evidenced increased speech variability in response to negatively valenced probe conditions across arousal condition, as well as in high levels of arousal across affective valence conditions. These results are consistent with the findings of Louth and colleagues (1998), which indicated that offenders with elevations in psychopathic traits spoke at an overall quieter volume and with less variation in volume than non-psychopathic offenders. However, also somewhat contradict the earlier work of Louth and colleagues (1998), which would imply subtypes characterized by greater elevations in Interpersonal and Affective trait domains would show greater constriction in terms of speech variability.

Thus, it would appear that for offenders in the present study within the moderate and severe externalizing classes, the Lifestyle and Antisocial trait domains exerted greater influence over

prosodic indicators of flat affect (i.e., F0 mean, jitter, amplitude, shimmer) in the context of a negatively valenced probes across levels of arousal, as well as in high arousal conditions across affective valence. The notable changes in classic indicators of flat affect observed suggest that when probed about negatively valenced autobiographical content, offenders within the externalizing subtypes' responses are anything but flat. Again, these findings are consistent with literature highlighting the impact of traditional Factor 2 psychopathic traits in terms of increased levels of affective and behavioral instability (Hicks et al., 2010; Olver et al., 2015; Poythress et al., 2010). As such, this pattern of results may hint to some form of emotion dysregulation (e.g., maladaptive suppression). Further, these findings may be interpreted with regard to the classic concept of "confusion of emotional polarity," such that psychopaths show a tendency to evaluate and process complicated linguistic stimuli based on their denotative rather than connotative or affectively-charged content (Hervé, Hayes, & Hare, 2003; Williamson, Harpur, & Hare, 1991; Williamson, Harpur, & Hare, 1990).

Alternatively, the observed increased speech variability within the moderate and severe externalizing offender classes may be related to difficulties in processing affectively-charged language. More specifically, psychopathy has been associated not only with difficulty processing prosodic and linguistic cues related to identification of emotion in others (Hare et al, 1988; Hiatt et al., 2002; Williamson et al., 1991), but also difficulty both storing and recalling affectively-charged autobiographical and factual information (Dolan & Fullam, 2005). These difficulties with regards to processing and integrating affectively-charged information obtained through language have been previously theorized to arise due to disturbances in interhemispheric integration (Hiatt, Lorenz, & Newman, 2002). Such difficulties in processing affectively-charged language may also be reflective of observed hypoactivation in the amygdala and anterior

cingulate cortex, areas of the brain relevant to emotion and attentional processes (Kiehl et al., 1999). As such, it may be that moderate and severe externalizing offenders may exhibit greater variability in prosodic output within negatively valenced or high arousal conditions as an impact of cognitive load.

Interestingly, results of the present study did not show significant differences between prototypical psychopathic offenders and the other classes in terms of speech variability across all four probe conditions. Contrarily, the pattern of slopes for prototypical offenders often paralleled that of moderate and severe externalizing offenders, though the pattern of differences did not reach traditional levels of statistical significance. Such a finding contradicts the classic notion of flattened affectivity in prototypical psychopathic offenders (Cleckley, 1976; de Almeida Brites et al., 2015; de Almeida Brites, 2016; Louth et al., 1998). However, it is important to note the aforementioned studies did not consider the impact of affective valence on prosodic output. Thus, the difference in results across previous and the current study may highlight the importance of examining variation in prosodic variables across affectively charged PCL-R interview questions, as differences between offender classes may emerge only within certain contexts.

Furthermore, results of supplemental correlational analyses suggested a stronger relationship between Lifestyle and Antisocial trait domains and prosodic variables related to speech variability. These findings are consistent with a larger emergent body of literature suggesting evidence of emotion dysregulation in psychopathy, with a particular emphasis on traditional Factor 2 traits (Garofalo & Neumann, 2020; Garofalo, Neumann, Zeigler-Hill, & Meloy, 2018). As such, it may be that Interpersonal and Affective trait domains somewhat counter-intuitively provide a buffer effect against dysregulation of speech output as a function of affective contexts.

Thus, the present study provides initial evidence contradicting flattened affective expression in psychopathy when examining natural speech using objective, computerized assessments. These findings have important clinical implications suggesting the potential utility of adjunctive computerized assessments of affective expression such as the CANS in assessing affective expression in psychopathy, given the low discriminatory power observed in the blunted affective expression item on the PCL-R (Neumann & Hare, 2008).

Conclusions

The goal of the present study was to replicate and extend the literature examining subtypes of psychopathic personality within a large sample of male offenders from the New Mexico prison system. Results were consistent with previous studies utilizing latent profile analysis with offenders representing a full range of PCL-R total scores (see Krstic et al., 2018; Klein Haneveld et al., 2018; Neumann, Vitacco et al., 2016) in which a four class solution represented the best model fit. Briefly, the emergent classes identified in the present study were consistent with *prototypical psychopathic offenders* (i.e., high elevations across all four facets), *moderate externalizing offenders* (i.e., higher elevations on Lifestyle and Antisocial facets, lower scores on Interpersonal and Affective facets; consistent with previous findings of a "sociopathic" or "secondary psychopathic" class), and *non-psychopathic offenders* (i.e.; low level scores across all four facests). Inconsistent with hypotheses or the previous literature, a *severe externalizing offender* class additionally emerged, which was characterized by higher elevations on Interpersonal and Affective facets, as well as substantial elevations on Lifestyle and Antisocial facets. Results at the person-centered level provide additional evidence both of the identification of theoretically relevant subtypes of psychopathic personality, as well as the utility of person-

centered analyses in the study of personality pathology more broadly to ascertain more nuanced relationships between personality traits and theoretically relevant external correlates.

Another goal of the current study was to examine differential relationships between identified subtypes of psychopathic personality and prosodic output across a series of affectively-charged probes of different valence and arousal levels within the context of a clinical interview. As previously mentioned, results of MANOVA showed significant two- and three-way interactions (i.e., psychopathy subtype x valence x arousal). Overall, findings revealed that offenders within the prototypical psychopath class were more fluid in terms of speech production than offenders in the remaining classes. Furthermore, evidence suggests that non-psychopathic offenders were impacted by affective valence and arousal level of the probe in terms of fluency of speech production than offenders within the remaining three classes. Taken together, these results indicate that affective valence may have a greater impact on non-psychopathic offenders' speech production relative to those within the externalizing and psychopathic classes, which may be associated with the link between Lifestyle and Antisocial trait domains and affective and behavioral instability. Conversely, high level elevations across psychopathic trait domains may possibly facilitate fluidity of speech output as a means of interpersonal manipulation for prototypical offenders.

Results further indicated that non-psychopathic offenders evidenced greater speech variability (i.e., larger average rate of subjectively defined pitch, larger average rate of change in subjectively defined pitch throughout a speech sample, louder average volume, and greater variation in volume) than moderate or severe externalizing offenders in the context of negatively valenced probes across levels of arousal. However, findings at the within subtype level suggest both moderate and severe externalizing offenders show greater variability in the presence of

negatively valenced probes, regardless of level of arousal. Taken together, these results suggest that high levels of traditional Factor 2 traits may contribute to flattened affective expression in positively, but not negatively valenced affective contexts. Such a finding may be reflective of literature highlighting the impact of traditional Factor 2 psychopathic traits in terms of increased levels of affective and behavioral instability with regards to negative affect (Hicks et al., 2010; Olver et al., 2015; Poythress et al., 2010). On the other hand, no significant differences emerged between prototypical psychopaths, characterized by high level elevations across all four trait domains, and other latent classes in terms of speech variability. These findings somewhat contradict the earlier work of Louth and colleagues (1998), which would imply subtypes characterized by greater elevations in Interpersonal and Affective, rather than Lifestyle and Antisocial trait domains, would show greater constriction in terms of speech variability.

Limitations, Clinical Implications, and Future Directions

While a first attempt at an admittedly challenging topic, the current study is not without limitations. Notably, due to constraints related to both integrity and availability of audio files for processing with the CANS protocol, as well as participants whose PCL-R interview was identified as missing probe conditions, the present study may have been under-powered to find significant effects, which may have led to Type II errors. However, it is important to note that the amount of missing data was minimal overall, and further analyses indicated data was missing completely at random. It is also important to note that corrections for statistical significance were not conducted, as such a correction would severely limit the exploratory nature of the present study and essentially erase any effects that may have been truly significant. Given the volume of analyses conducted by the present study, the decision to forego statistical correction may have contributed to an increased likelihood of statistical error and significant findings may have been

due to chance. Furthermore, many of the prosodic indices utilized in the present study violated the assumption of normality necessary to conduct comparisons of mean values across identified psychopathic subtypes. Given the exploratory nature of the present study and the use of behavioral data, it was decided to forgo transformation of non-normal speech indices in order to aid interpretation of findings (Osborne, 2002). However, examination of Mahalanobis distance indices suggested that assumptions of multivariate normality were not violated. Finally, the present study was limited in its use of an adult male offender sample. As such, these findings may not be generalizable to female offenders or juvenile offenders with psychopathic traits. Although the present study had several limitations, it also had several notable strengths, namely, its use of an offender sample and natural speech data collected from the context of the PCL-R interview. Furthermore, the present study's use of probes of differential valence and arousal levels allowed for examinations in variance in speech as a function of emotional context of the probe.

Despite these critiques, the current study provides valuable information highlighting differences in prosody across affectively-charged contexts among subtypes of psychopathic offenders. The findings implicating greater prosodic disruption in terms of speech variability in subtypes characterized by pronounced elevations in Lifestyle and Antisocial facets is consistent with literature indicating greater negative affect in offenders with elevations in these trait domains, as well as emerging evidence suggesting emotion dysregulation in psychopathy (Garofalo & Neumann, 2018; Poythress et al., 2010). Further, although prototypical psychopaths appeared more fluent in terms of speech production, they demonstrated greater variance in indices of speech variability, somewhat contradicting the notion of flat affect. Taken together, the results of the present study indicate that flattened affective responding and prosodic

dysfluency within offenders of differing psychopathic subtypes is dependent upon affective context in terms of valence and arousal. As such, offenders with psychopathic traits may not be as “flat” in their overall affective responding as previously theorized. These findings highlight the clinical utility of the inclusion of automated measures of natural speech including a variety of samples reflecting differing emotional states in assessments of affective functioning in offenders. Such an assessment could provide valuable adjunctive data to clinician-rated measures with regards to potential affective dysregulation. Further, the results of computerized assessments of natural speech could be beneficial to clinicians with regards to treatment and intervention planning. Data regarding prosodic disruption in response to affectively-ladened probes could be clinically useful in terms of identifying targets for intervention with regards to affective dysregulation in offender populations. In future research, it may be advantageous to link the speech variables directly to aspects of neurobiology and criminal recidivism, as well as examine variance in natural speech within a female offenders or juvenile population. Further, future studies should consider changes in prosodic output as a function of treatment response in offender populations.

Table 1

Computerized Acoustic Analysis Variables Examined in the Present Study.

Variable	Description	Increasing scores reflect	Units of Measure
	Speech Production		
Recording Length	Length of the total speech sample in milliseconds (ms)	Longer speech samples	Milliseconds
Latency to 1st Utterance	Length of silence, in ms, prior to initial utterance	Longer time to begin speech	Milliseconds
Silence Percent	Percent of time not speaking	Less % of time not speaking	Percentage
Pause Mean	Average pause length in ms	Longer average pauses	Milliseconds
Longest Pause	Longest pause length in ms	Increased pause length	Milliseconds
Shortest Pause	Shortest pause length in ms	Increased pause length	Milliseconds
Utterance Frequency	Total number of utterances (> 150 ms)	More utterances	# of utterances per 2 min. of speech
Utterance Mean	Average utterance length in ms	Longer average utterances	Milliseconds
	Fundamental Frequency (F0)		
Intonation	Variability in pitch – both within utterance (i.e. locally) and across utterances (i.e. globally)	Greater variability in pitch	Decibels
F0 Mean	Average F0 values computed within utterances and averaged across all utterances	Greater variability in pitch	Semitones
Jitter	Absolute value of average change in consecutively voiced frames within utterance, averaged across utterances	Increasing levels of perturbation in F0 signal	Semitones
	Vowel Articulation		
Δ Tongue Articulation	Average rate of change of First Format Frequency (F1) and Second Format Frequency (F2) variability	Greater vowel articulation	Semitones

(table continues)

Variable	Description	Increasing scores reflect	Units of Measure
	Intensity		
Amplitude	The mean volume	Greater volume	Decibels
Emphasis	Average rate of change in volume variability in consecutively voiced frames within utterance, averaged across utterances	Greater change in volume	Decibels
Shimmer	Absolute value of average change in volume in consecutively voiced frames within utterance, averaged across utterances	Increasing levels of perturbation in the intensity signal	Decibels

Table 2

Psychopathy Checklist-Revised (PCL-R) Probes of Interest Varying on the Basis of Valence and Arousal for Speech Isolation

Probe of Interest (Valence_Arousal)	Begin Isolation	End Isolation
Positive_High	What do you think love is or what do you think love feels like?	Have you ever had a live-in or marital relationship?
Positive_Low	What are your main accomplishments?	What is your main weakness?
Negative_High	What sorts of things make you angry?	Have you ever gotten in physical fights?
Negative_Low	What's the saddest you've ever been?	Have you even been depressed?

Table 3

Demographic Statistics for the Overall Sample and Within Latent Classes

Variable	Overall Sample (*N* = 469)				Non-Psychopathic Offenders (*n* = 83)		Moderate Externalizing Offenders (*n* = 222)		Severe Externalizing Offenders (*n* = 124)		Prototypical Psychopathic Offenders (*n* = 40)	
	Min	Max	M	SD	M	SD	M	SD	M	SD	M	SD
Participant Age	17	60	34.18	9.31	37.42	10.27	32.93	8.92	33.70	9.19	35.85	8.13
FSIQ (WASI-II)	72	137	97.54	13.65	97.51	14.50	96.42	12.43	98.00	14.03	102.28	16.29
Education (Years)	5	20	9.681	3.70	10.41	3.64	9.12	3.40	9.54	3.75	11.76	4.38
PCL-R Total Score	3.20	37	20.75	6.55	11.47	3.23	20.01	3.75	25.14	4.06	30.53	3.88
Affective Facet Mean	0	2	0.90	0.51	0.52	0.48	0.87	0.44	1.05	0.48	1.46	0.38
Lifestyle Facet Mean	0	2	1.17	0.43	0.59	0.28	1.14	0.36	1.34	0.34	1.39	0.37
Interpersonal Facet Mean	0	2	0.52	0.49	0.17	0.21	0.24	0.19	0.88	0.21	1.63	0.23
Antisocial Facet Mean	0	2	1.51	0.40	0.97	0.33	1.59	0.30	1.69	0.33	1.65	0.23

Table 4

*Descriptive Statistics in Overall Sample for Prosodic Variables Generated by CANS Across Probe Conditions (*n = *469)*

Variable	Pos_High		Pos_Low		Neg_High		Neg_Low	
	M	SD	M	SD	M	SD	M	SD
Recording Length	34071.79	34388.11	20568.31	22772.84	65106.45	73447.97	41395.11	54204.62
Latency to 1st Utterance	2913.41	2480.32	2573.47	2463.39	218.57	399.36	121.79	316.97
Silence Percent	132.11	329.37	159.07	361.08	3534.29	4172.92	3123.62	2878.37
Pause Mean	144537.34	150724.26	183510.44	179017.60	78774.55	95610.80	149696.30	162326.82
Shortest Pause	23182.17	163015.36	21918.68	154012.53	5655.95	77394.20	21191.14	153606.20
Longest Pause	736498.12	541291.32	729629.07	549792.11	614159.22	549471.52	752135.06	531854.92
Utterance Frequency	143.69	325.53	165.93	358.30	240.02	389.72	136.47	312.93
Utterance Mean	1180.64	2659.03	1171.32	2306.35	1084.78	1989.44	1364.49	4159.09
Intonation	163.59	364.88	218.70	409.23	218.67	409.24	157.15	358.90
F0 Mean	202.32	308.39	235.45	341.41	274.46	372.79	192.49	297.31
Jitter	130.10	336.33	166.31	372.31	208.89	406.52	119.46	324.22
Δ Tongue Articulation	167.46	363.20	222.52	407.23	222.41	407.29	160.97	357.28
Amplitude	136.49	333.93	171.36	370.10	219.54	408.79	158.39	358.38
Emphasis	164.80	364.36	219.95	408.58	215.17	403.33	127.35	324.63
Shimmer	130.54	336.16	166.71	372.13	209.29	406.31	122.01	326.55

Table 5

Model Fit of the Latent Profile Analyses

# Lat. Cl.	# Free Param.	Log-Lklhd	BIC	Adjusted BIC	AIC	Class. Acc.	Entropy
1	8	-1187.11	2423.42	2398.03	2390.22	-	-
2	13	-1075.60	2231.16	2189.90	2177.20	.84 – .96	.78
3	18	-1009.31	2129.32	2072.19	2054.61	.82 – .91	.73
4	23	-984.99	**2111.44**	**2038.44**	**2015.98**	.77 – .88	.75
5	28	-969.40	2111.01	2022.14	1994.79	.77 – .89	.78

Table 6

Latent Profile Analysis Results: PCL-R Mean Facet Scores by Subtype in 4 Class Solution

Latent Class	*n*	Interpersonal	Affective	Lifestyle	Antisocial
Non-psychopathic	83	0.18	0.55	0.64	1.02
Moderate Externalizing	222	0.25	0.86	1.13	1.58
Severe Externalizing	124	0.84	1.07	1.33	1.69
Prototypical Psychopathic	40	1.61	1.40	1.39	1.65

Table 7

*Within-Subjects MANOVA Examining Group Differences in Latent Classes Across Valence and Arousal (*n = *469)*

CANS Variable	Group x Valence			Group x Arousal			Valence x Arousal			Group x Valence x Arousal		
	F	*p*	η^2	*F*	*p*	η^2	*F*	*p*	η^2	*F*	*p*	η^2
Recording Length	1.69	.17	.01	1.56	.19	.01	9.39	**.002***	.02	3.19	**.02***	.02
Latency to 1st Utterance	.72	.54	.004	.57	.64	.003	.08	.77	.00	.10	.96	.00
Silence Percent	.33	.80	.005	1.52	.21	.008	5.76	**.02***	.01	2.59	**.05***	.02
Pause Mean	1.28	.28	.01	.78	.51	.005	3.50	.06*	.01	.63	.60	.004
Shortest Pause	.18	.91	.001	1.38	.25	.009	1.20	.27	.002	.71	.55	.004
Longest Pause	.19	.90	.001	2.37	*.07**	.02	5.76	**.02***	.01	2.36	*.07**	.01
Utterance Frequency	.23	.87	.001	1.37	.25	.01	6.42	**.01***	.01	2.46	*.06**	.02
Utterance Mean	.85	.47	.005	.52	.67	.003	1.59	.21	.003	1.13	.34	.007
Intonation	.94	.42	.006	.82	.48	.005	4.21	**.04***	.01	2.16	*.09**	.01
F0 Mean	.51	.67	.003	2.07	*.10**	.01	5.71	**.02***	.01	2.50	**.05***	.02
Jitter	.52	.67	.003	2.08	*.10**	.01	5.72	**.02***	.01	2.49	**.05***	.02
Δ Tongue Articulation	.94	.42	.006	.84	.47	.005	4.25	**.04***	.01	2.16	*.09**	.01
Amplitude	.44	.73	.002	2.18	*.09**	.01	5.52	**.02***	.01	2.48	*.06**	.02
Emphasis	.94	.42	.006	.84	.47	.005	4.19	**.04***	.01	2.17	*.09**	.01
Shimmer	.44	.73	.002	2.19	*.09**	.01	5.49	**.02***	.01	2.47	*.06**	.02

Note. CANS = Computerized Assessment of Natural Speech; **xx*** = p <.05; *xx** = p < .10

Table 8

Results of Correlations between PCL-R Total Score, PCL-R Facets, and CANS Variables in Positive Valence, High Arousal Condition

CANS Variable	PCL-R Total	Interpersonal	Affective	Lifestyle	Antisocial
Recording Length	0.05	0.05	0.02	0.06	0.08
Silence Percentage	-0.05	-0.01	0.01	-0.04	-.10*
Latency to 1st Utterance	0.05	0	0.002	-0.02	.14**
Utterance Frequency	-0.06	-0.01	0.01	-0.05	-.11*
Utterance Mean	0.07	0.05	0.09	.09*	0.02
Shortest Pause	0.03	-0.04	0.04	0.06	0.02
Longest Pause	-.29**	-.22**	-.23**	-.23**	-.14**
F0 Mean	-0.06	-0.02	0.01	-0.05	-.11*
Jitter	-0.06	-0.02	0.004	-0.05	-.11*
Amplitude	-0.07	-0.02	0.002	-0.05	-.11*
Shimmer	-0.06	-0.02	0.004	-0.05	-.11*
Delta Tongue Articulation	-0.03	-0.02	0.02	-0.01	-0.08
Emphasis	-0.03	-0.02	0.02	-0.01	-0.08
Intonation	-0.03	-0.02	0.02	-0.01	-0.08
Pause Mean	-.21**	-.17**	-.11*	-.17**	-.11*

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 9

Results of Correlations between PCL-R Total Score, PCL-R Facets, and CANS Variables in Positive Valence, Low Arousal Condition

CANS Variable	PCL-R Total	Interpersonal	Affective	Lifestyle	Antisocial
Recording Length	0.04	.17**	0.01	-0.06	-0.03
Silence Percentage	-0.07	-0.03	-0.08	-0.02	-0.04
Latency to 1st Utterance	-0.03	-0.003	-0.04	-.11*	0.05
Utterance Frequency	-0.07	-0.03	-0.08	-0.02	-0.05
Utterance Mean	0.02	0.06	0.01	-0.01	-0.004
Shortest Pause	-0.04	-0.08	-0.03	-.10*	0.03
Longest Pause	-.24**	-.19**	-.15**	-.20**	-.16**
F0 Mean	-0.07	-0.03	-0.07	-0.03	-0.04
Jitter	-0.07	-0.03	-0.07	-0.03	-0.04
Amplitude	-0.07	-0.03	-0.07	-0.04	-0.04
Shimmer	-0.07	-0.03	-0.07	-0.03	-0.04
Delta Tongue Articulation	-0.06	-0.04	-0.05	-0.06	0
Emphasis	-0.06	-0.04	-0.05	-0.06	0.001
Intonation	-0.06	-0.04	-0.05	-0.06	0.001
Pause Mean	-.17**	-.19**	-0.05	-.14**	-.09*

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 10

Results of Correlations between PCL-R Total Score, PCL-R Facets, and CANS Variables in Negative Valence, High Arousal Condition

CANS Variable	PCL-R Total	Interpersonal	Affective	Lifestyle	Antisocial
Recording Length	0.02	0.05	-0.02	0.03	0.01
Silence Percentage	0.01	-0.01	0.05	-0.002	-0.01
Latency to 1st Utterance	-0.05	0.004	-0.06	-0.03	0.02
Utterance Frequency	-0.01	-0.01	0.04	-0.01	-0.02
Utterance Mean	0.04	0.07	0.03	0.02	0.04
Shortest Pause	0.002	0.04	0.003	0	-0.003
Longest Pause	-.32**	-.22**	-.25**	-.25**	-.20**
F0 Mean	-0.01	-0.02	0.04	-0.01	-0.02
Jitter	-0.01	-0.02	0.04	-0.01	-0.02
Amplitude	-0.01	-0.02	0.04	-0.01	-0.02
Shimmer	-0.01	-0.02	0.04	-0.01	-0.02
Delta Tongue Articulation	0	0.001	0.05	-0.003	-0.02
Emphasis	0	0.001	0.05	-0.003	-0.02
Intonation	0	0.001	0.05	-0.002	-0.02
Pause Mean	-.25**	-.19**	-.15**	-.22**	-.16**

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Table 11

Results of Correlations between PCL-R Total Score, PCL-R Facets, and CANS Variables in Negative Valence, Low Arousal Condition

CANS Variable	PCL-R Total	Interpersonal	Affective	Lifestyle	Antisocial
Recording Length	.09*	.11*	-0.07	.12**	0.07
Silence Percentage	-.10*	-0.02	-0.05	-0.09	-.09*
Latency to 1st Utterance	0.04	-0.003	0.02	0.04	0.04
Utterance Frequency	-.10*	-0.02	-0.07	-0.09	-.094*
Utterance Mean	0.06	0.07	0.06	0.04	0.04
Shortest Pause	-0.03	0.004	0.02	-0.05	0.03
Longest Pause	-.27**	-.24**	-.20**	-.19**	-.15**
F0 Mean	-.11*	-0.03	-0.04	-.11*	-.10*
Jitter	-.11*	-0.03	-0.04	-.11*	-.10*
Amplitude	-.10*	-0.02	-0.04	-.10*	-.09*
Shimmer	-.10*	-0.02	-0.04	-.10*	-.09*
Delta Tongue Articulation	-0.06	0.03	0.02	-.10*	-0.05
Emphasis	-0.06	0.03	0.02	-.10*	-0.05
Intonation	-0.06	0.03	0.02	-.10*	-0.05
Pause Mean	-.17**	-.14**	-0.06	-.20**	-0.06

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

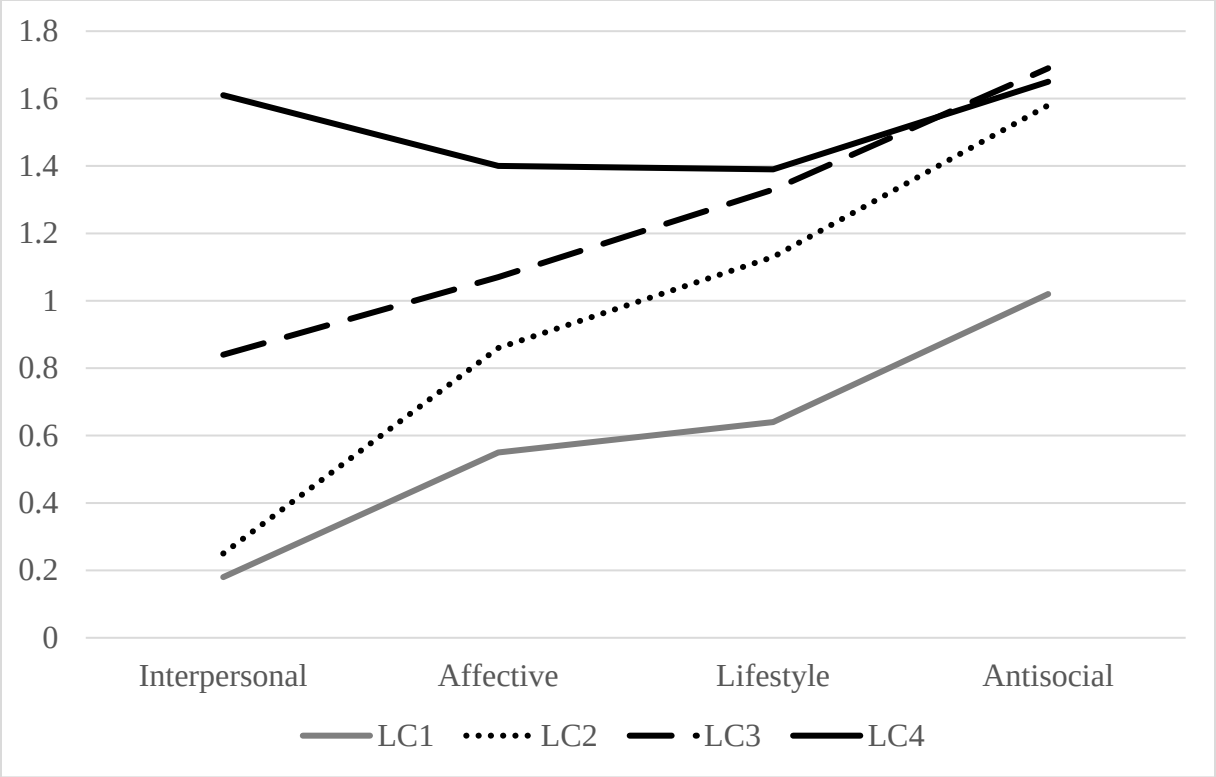
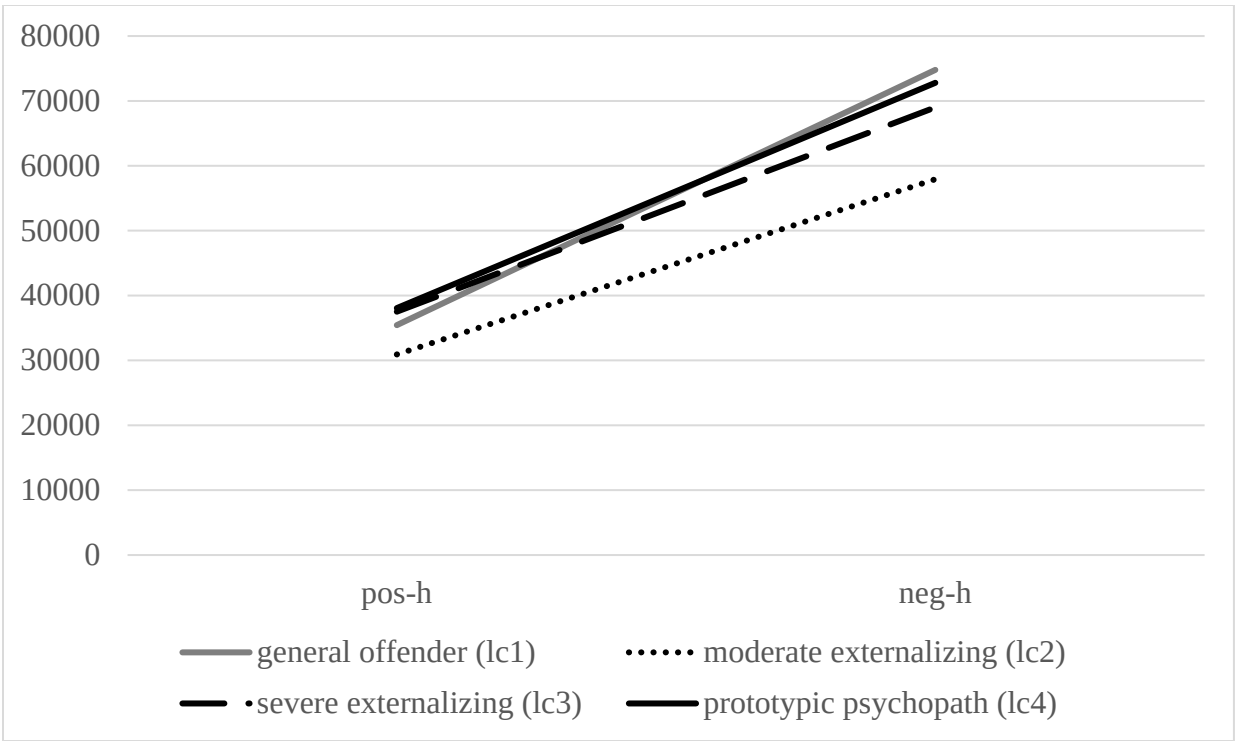


Figure 1. LPA results: PCL-R mean facet scores by subtype in 4 class solution.



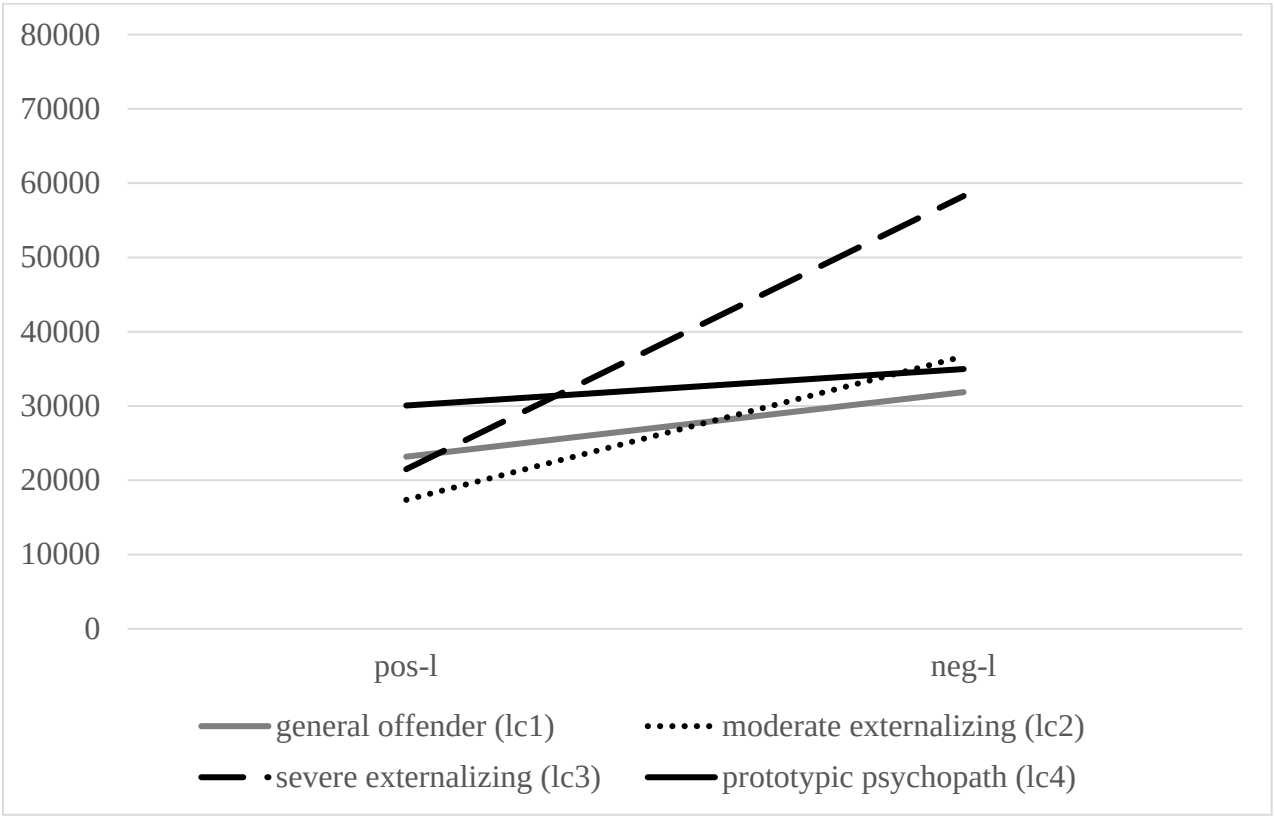
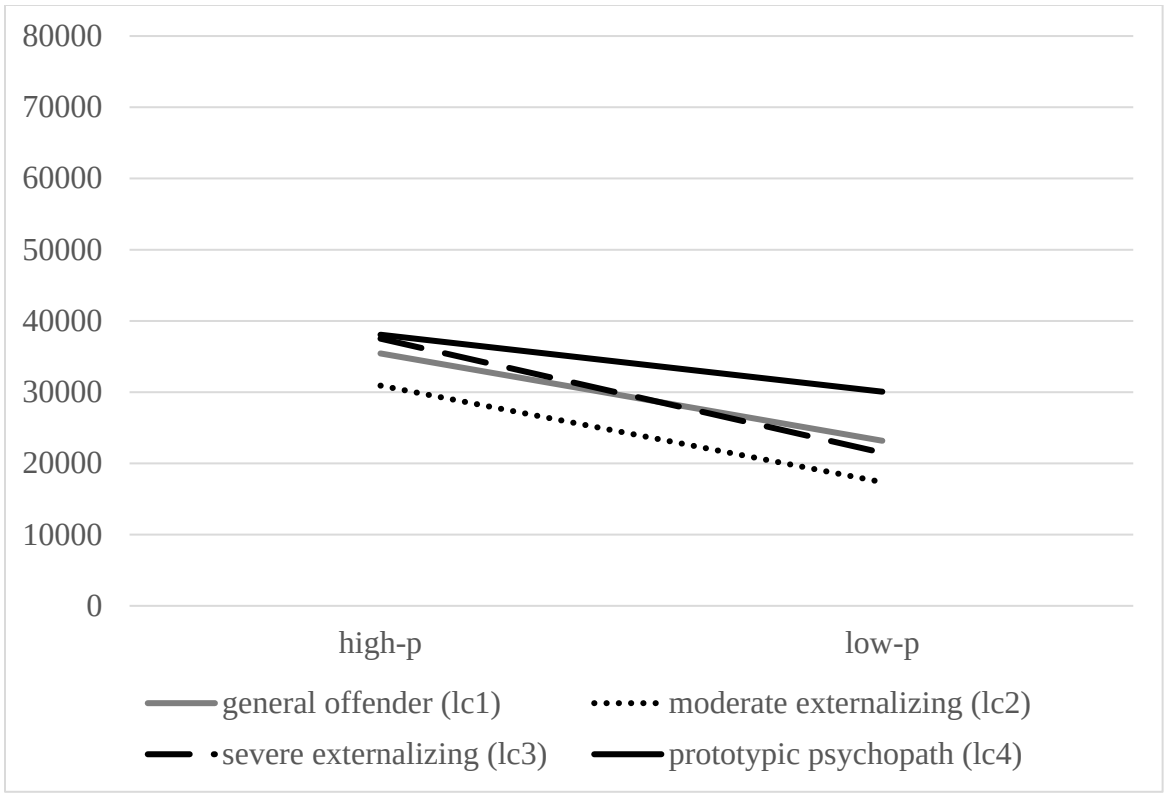


Figure 2. Significant subtype x valence interaction within high and low arousal conditions for recording length.



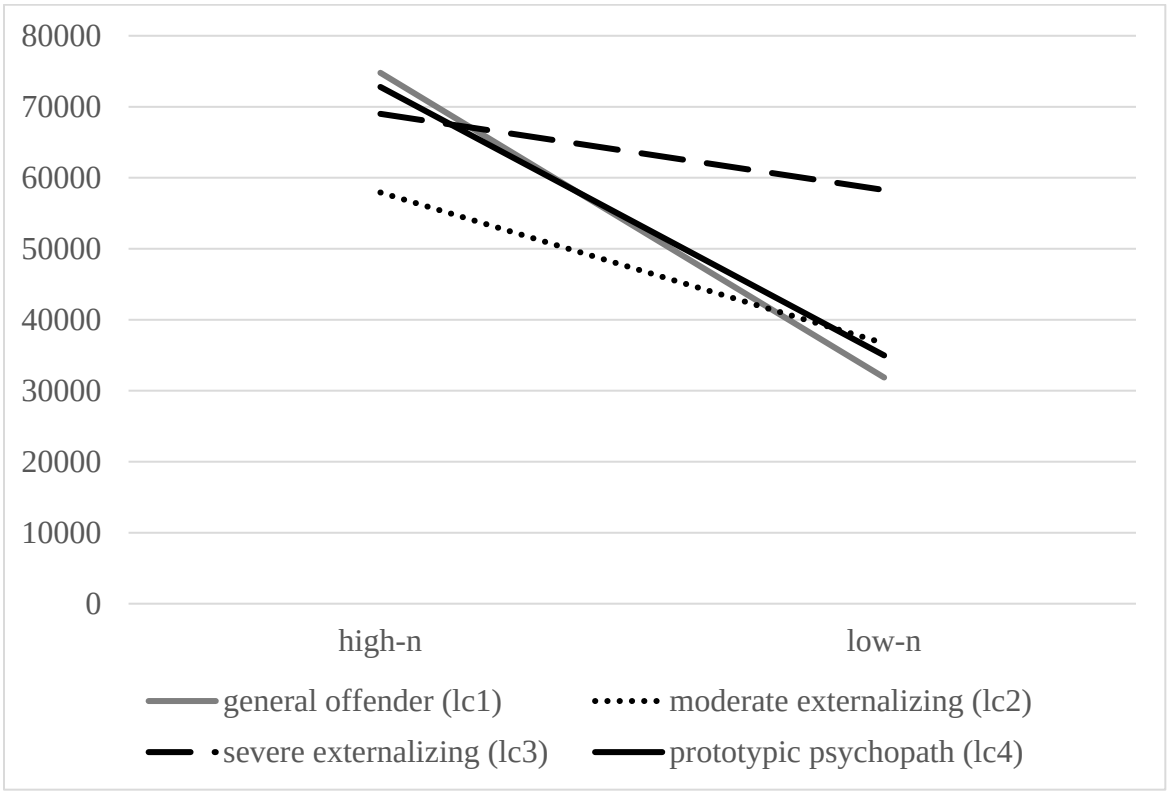
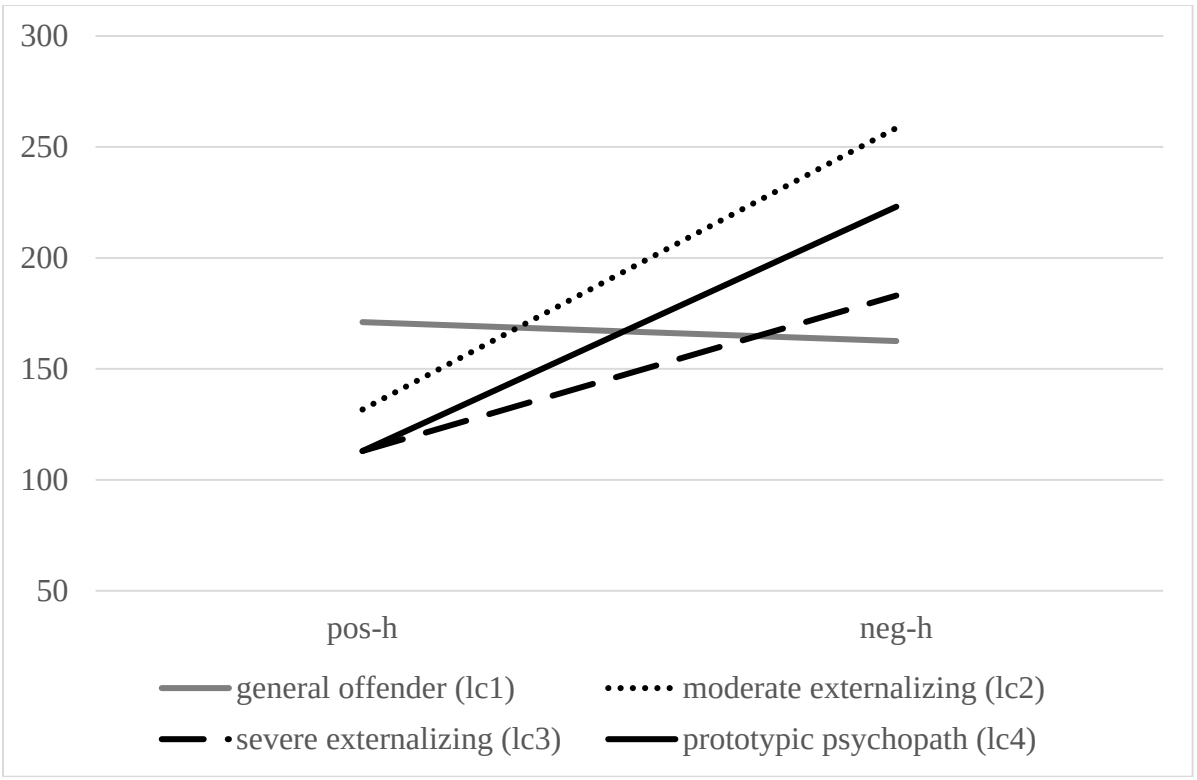


Figure 3. Significant subtype x arousal interaction within positively and negatively valenced conditions for recording length.



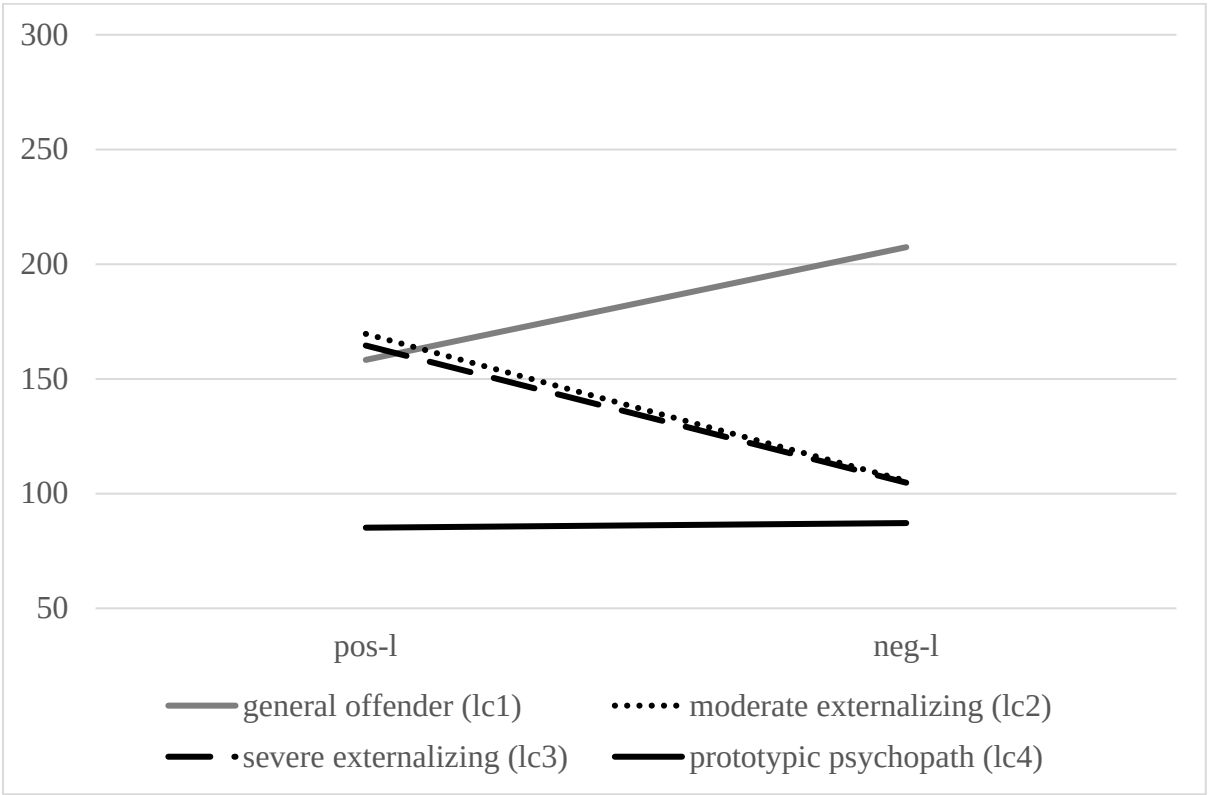


Figure 4. Significant subtype x valence interaction within high and low arousal conditions for silence percent.

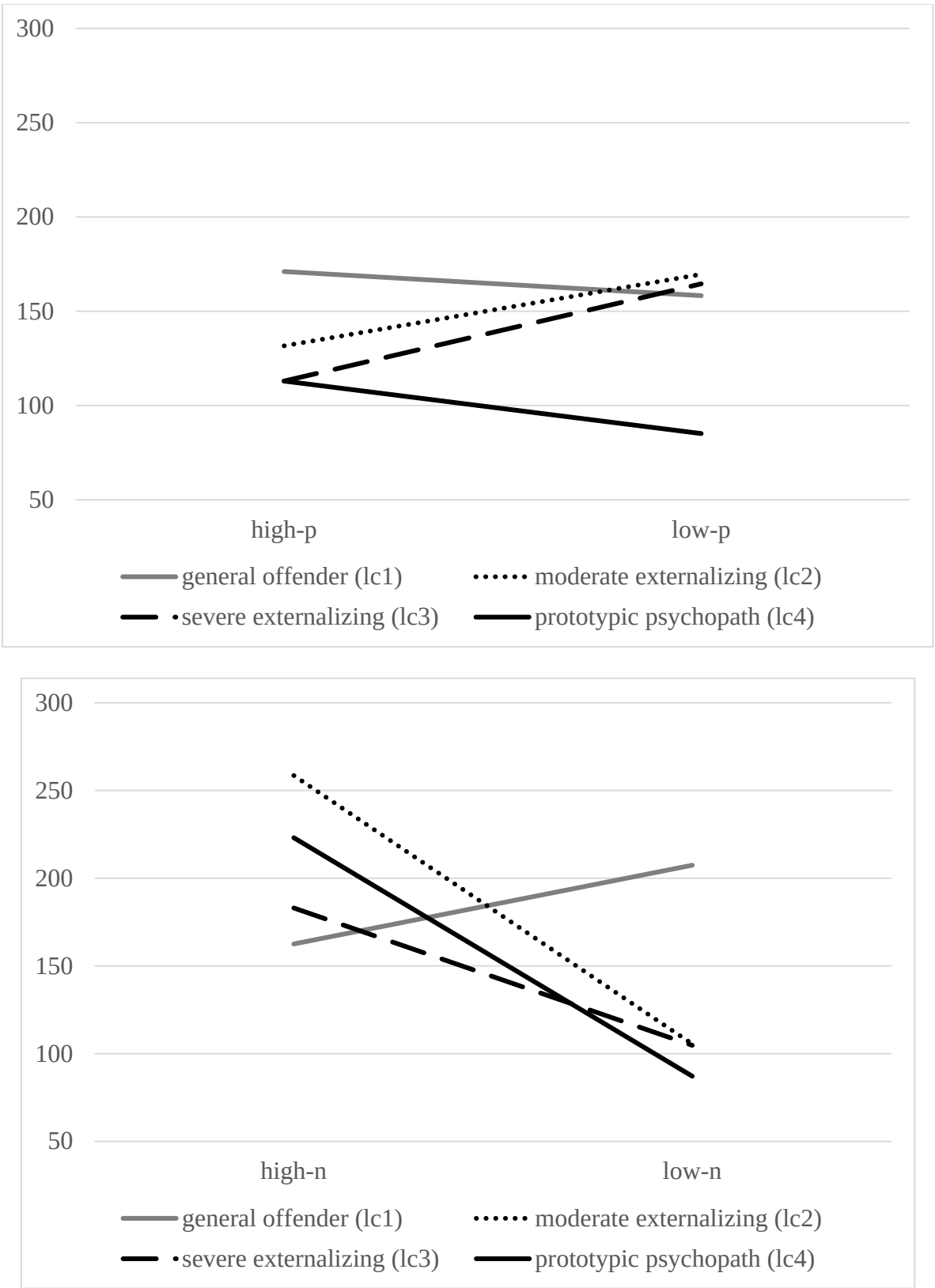


Figure 5. Significant subtype x arousal interaction within positively and negatively valenced conditions for silence percent.

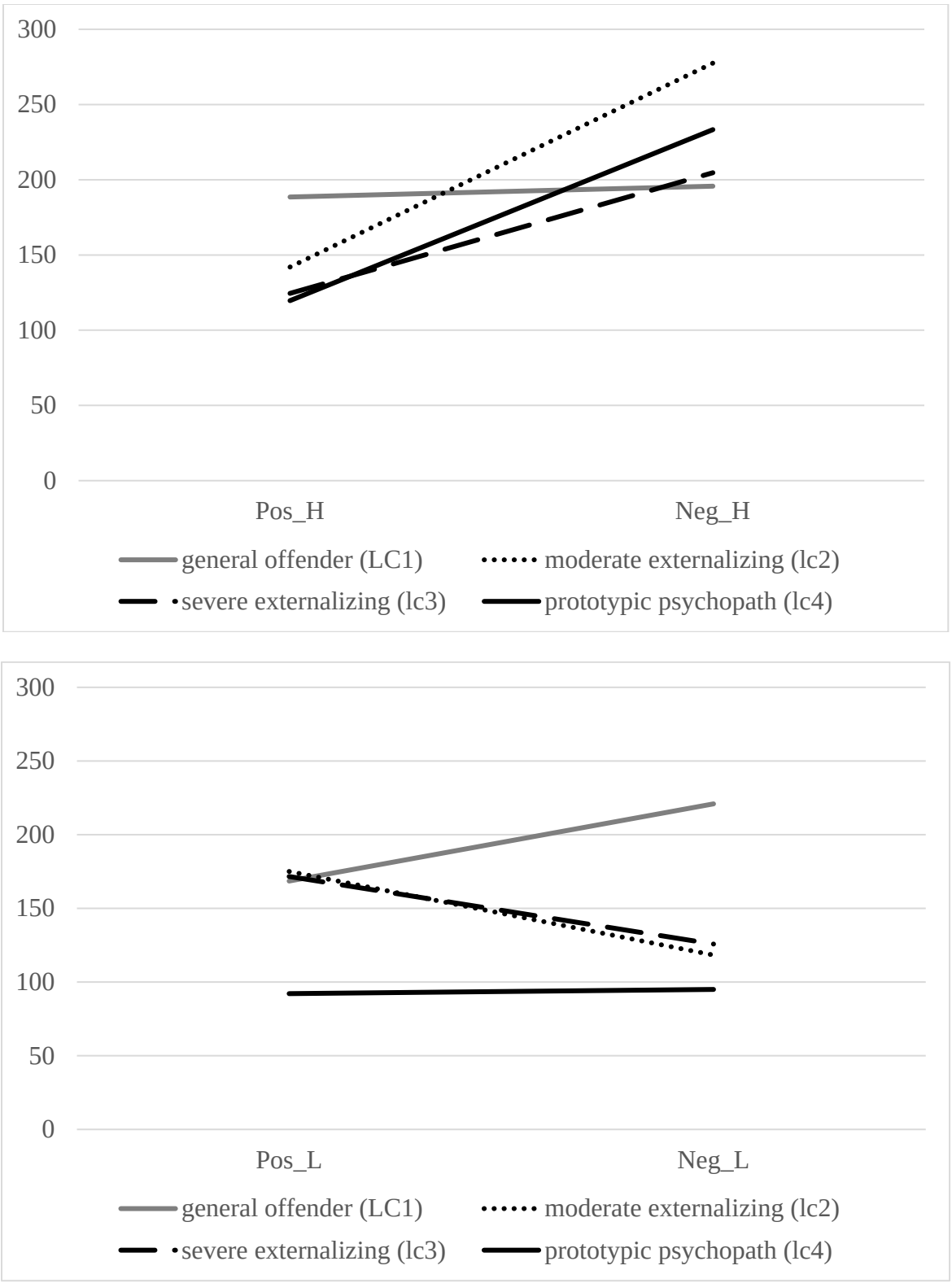


Figure 6. Significant subtype x valence interaction within high and low arousal conditions for utterance frequency.

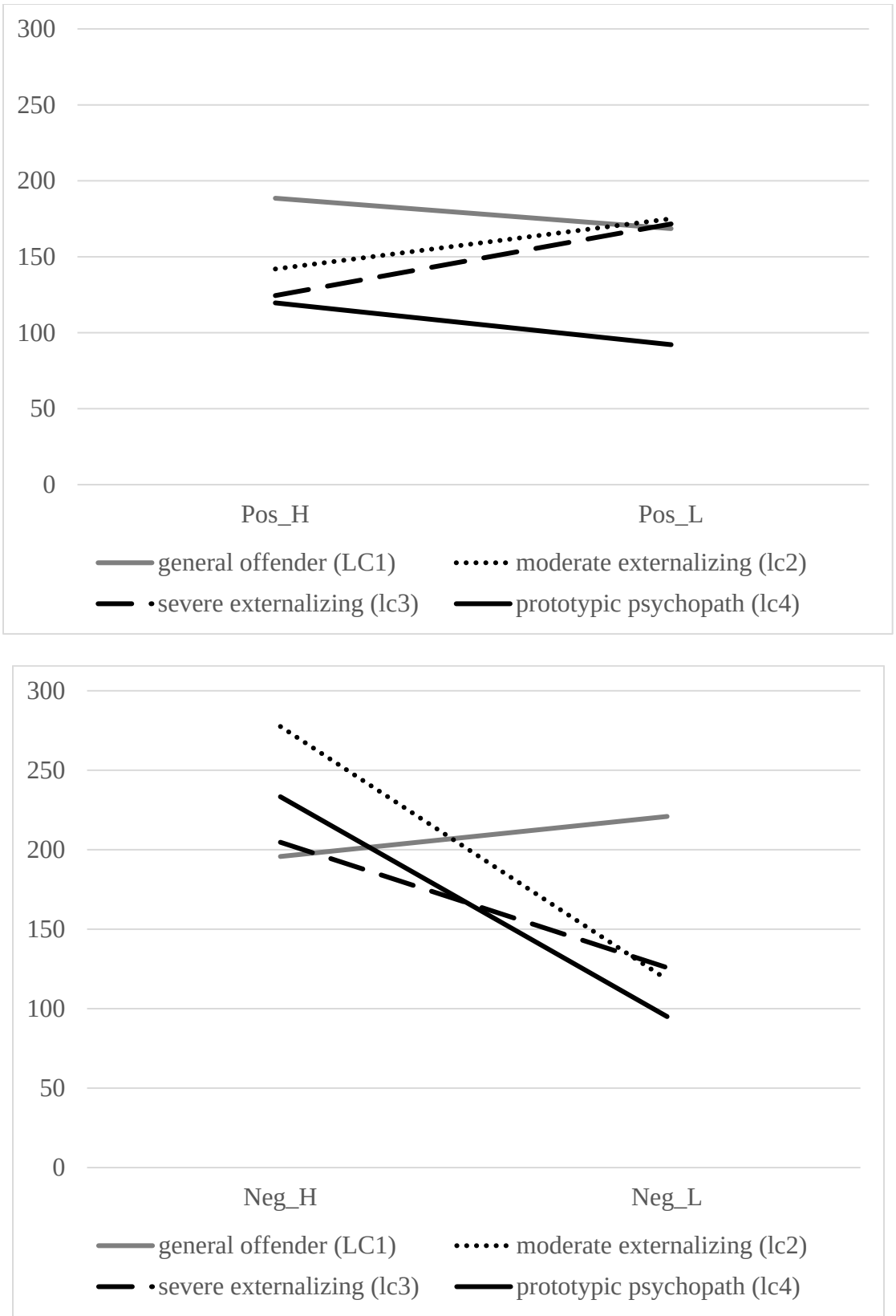


Figure 7. Significant subtype x arousal interaction within positively and negatively valenced conditions for utterance frequency.

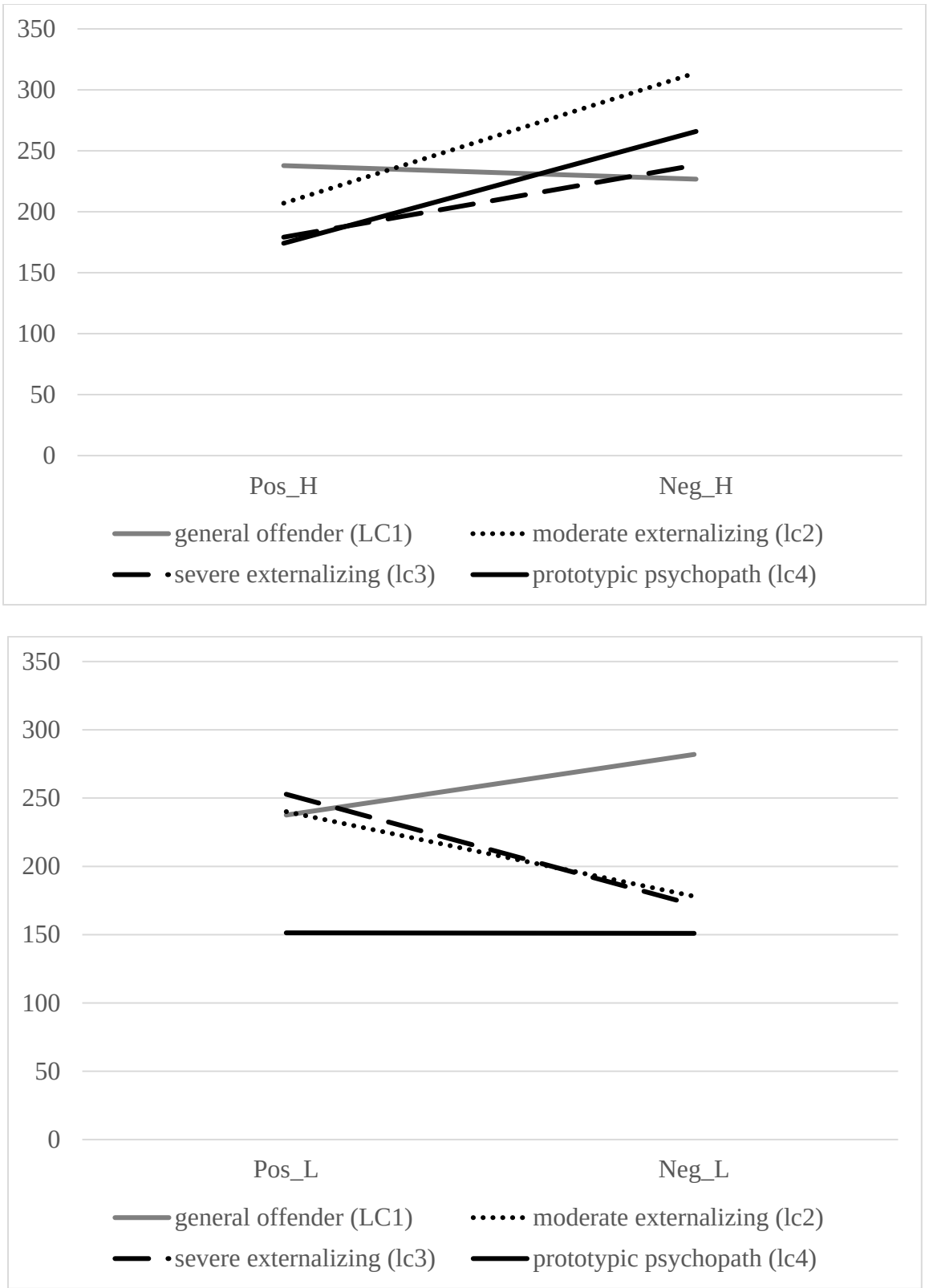


Figure 8. Significant subtype x valence interaction within high and low arousal conditions for F0 mean.

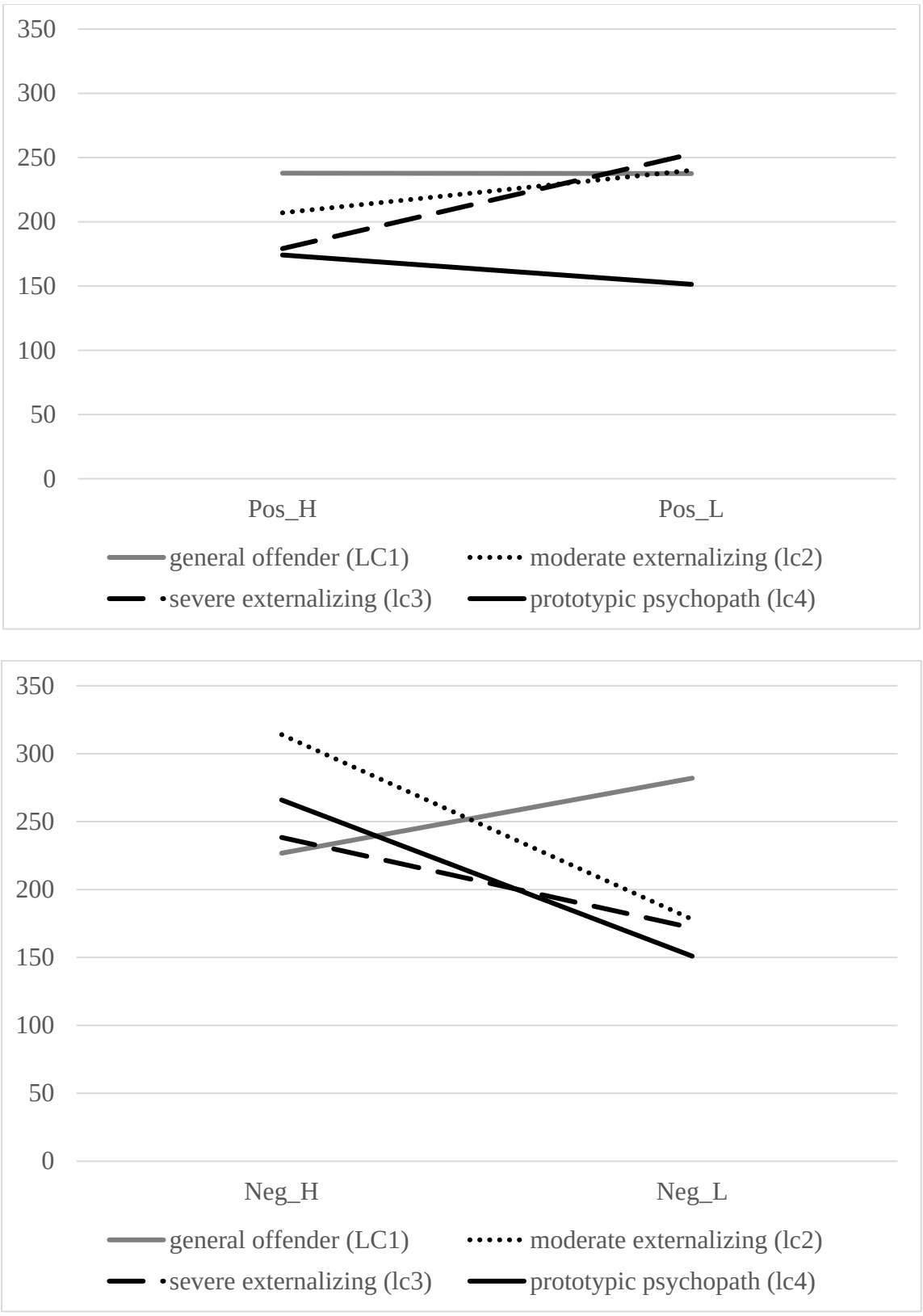


Figure 9. Significant subtype x arousal interaction within positively and negatively valenced conditions for F0 mean.

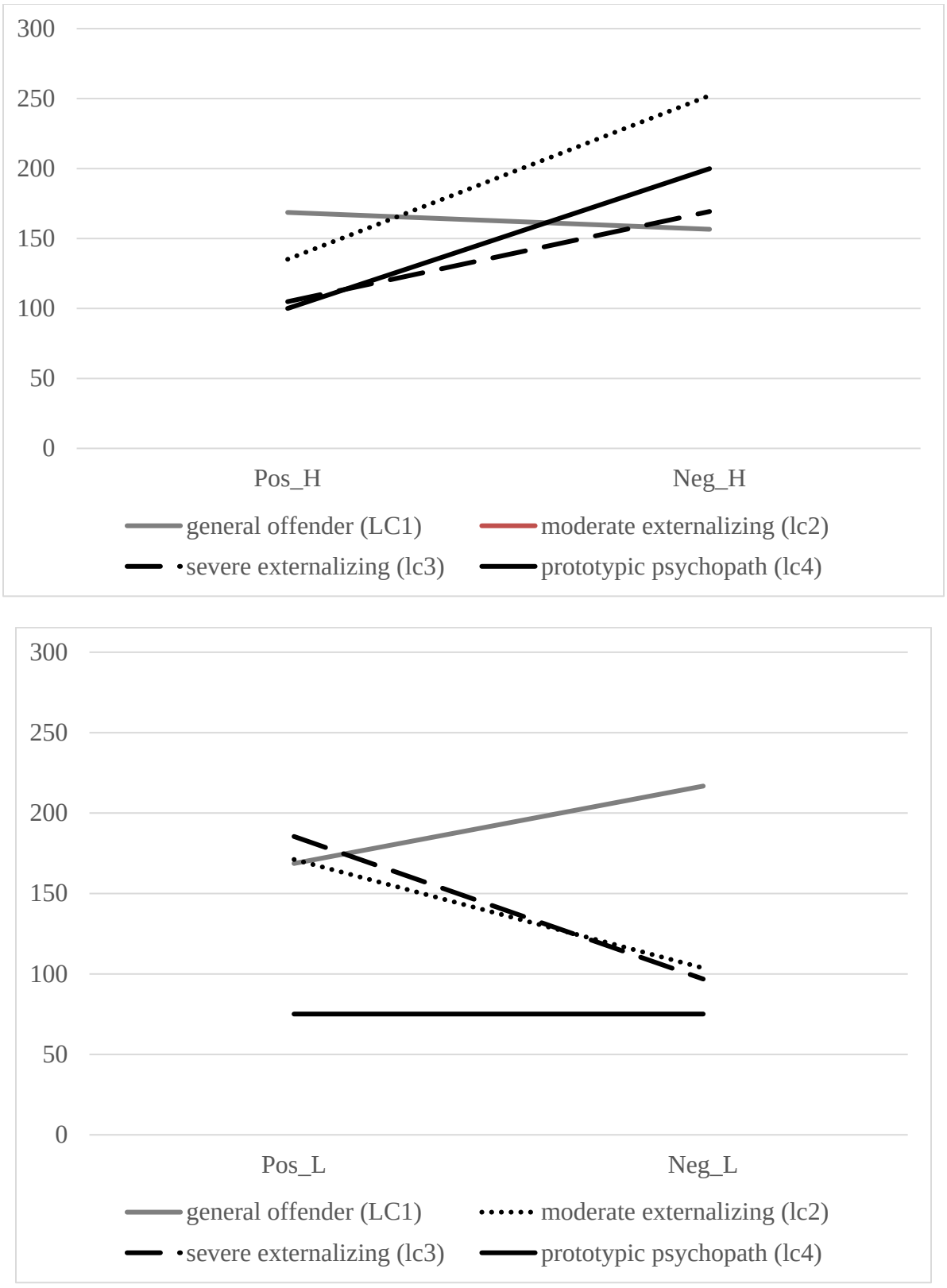
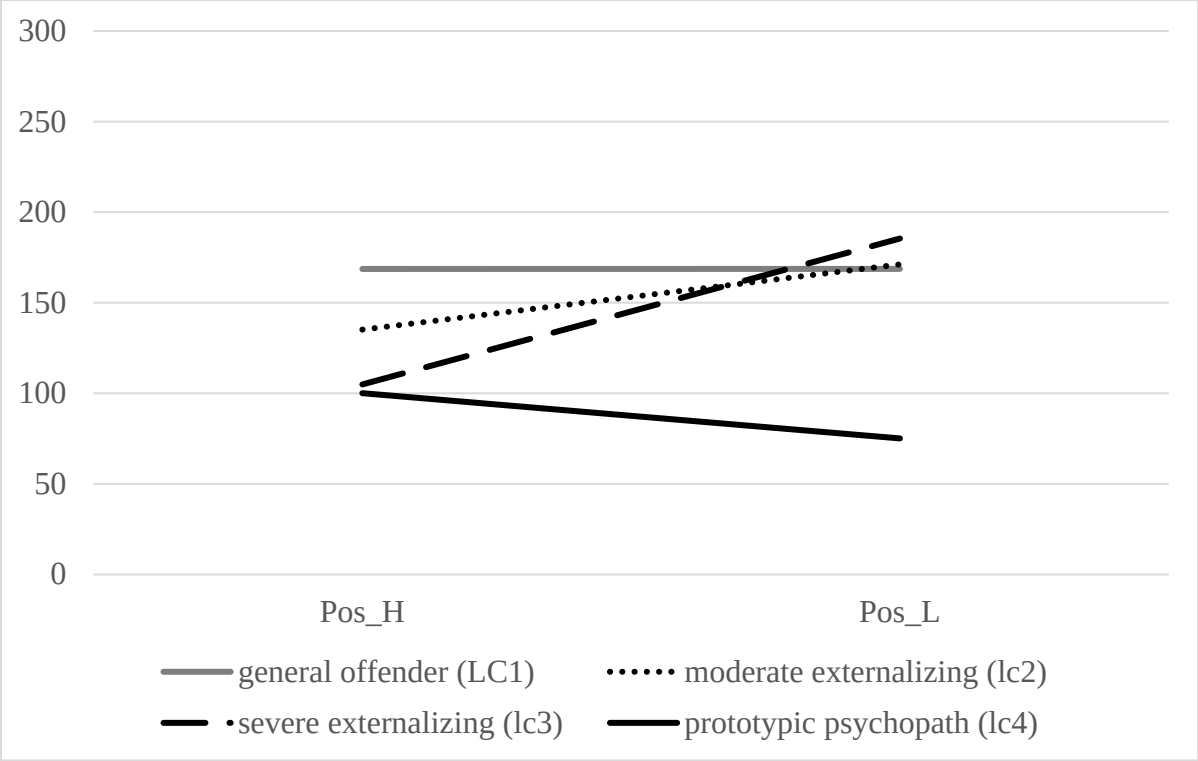


Figure 10. Significant subtype x valence interaction within high and low arousal conditions for jitter.



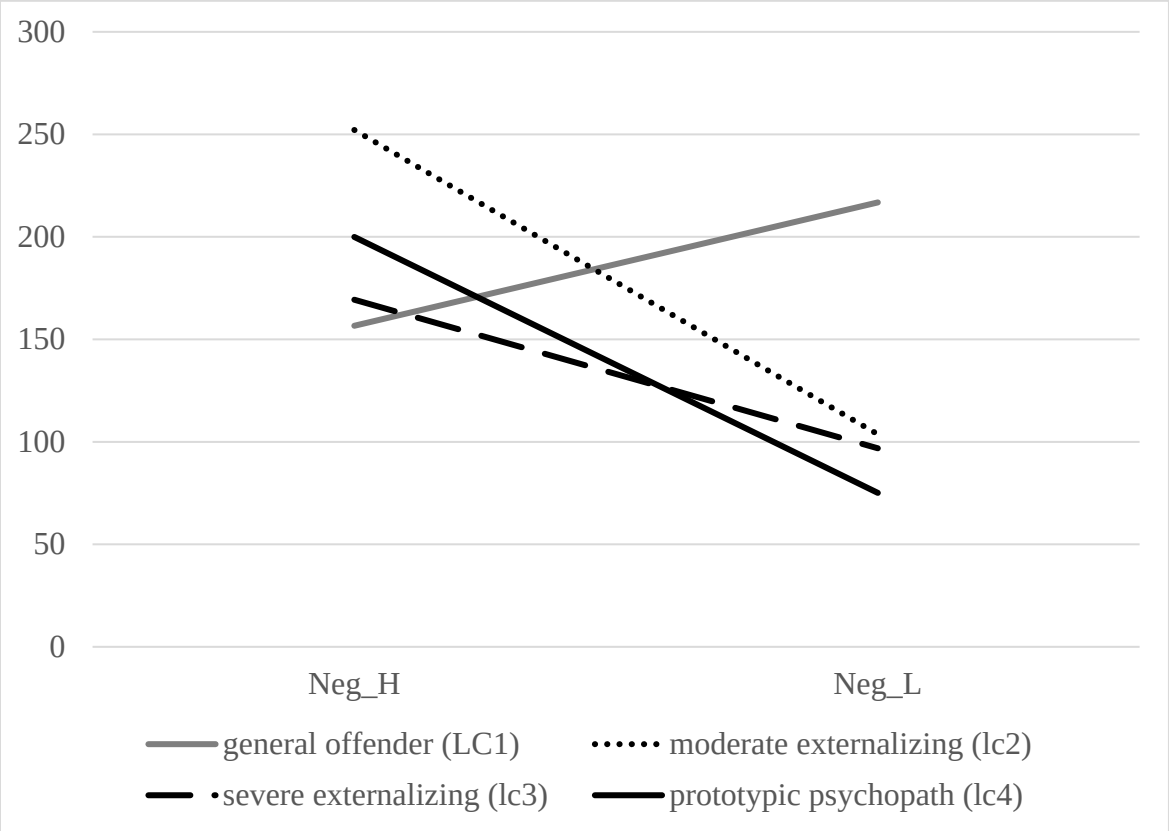


Figure 11. Significant subtype x arousal interaction within positively and negatively valenced conditions for jitter.

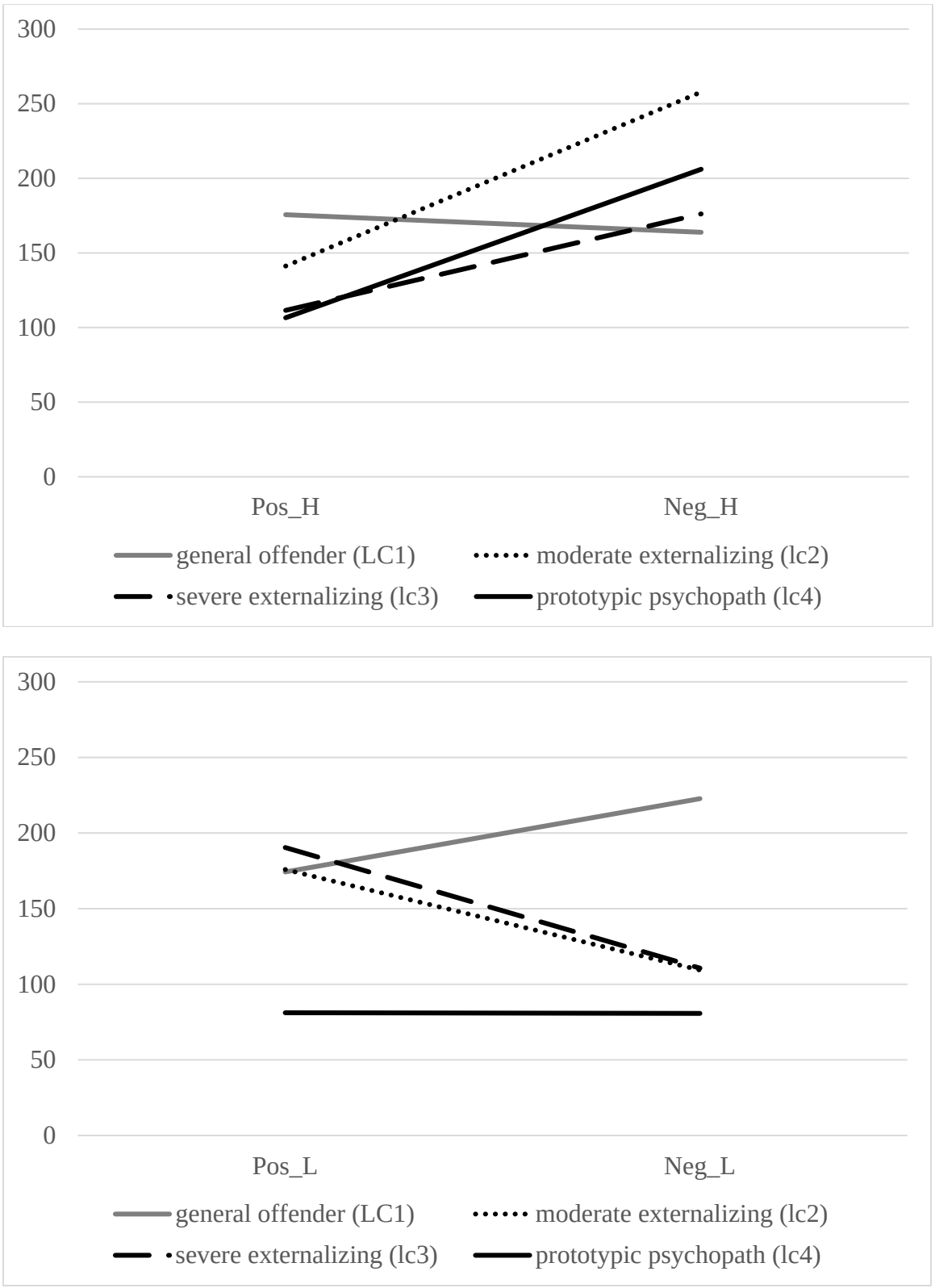


Figure 12. Significant subtype x valence interaction within high and low arousal conditions for amplitude.

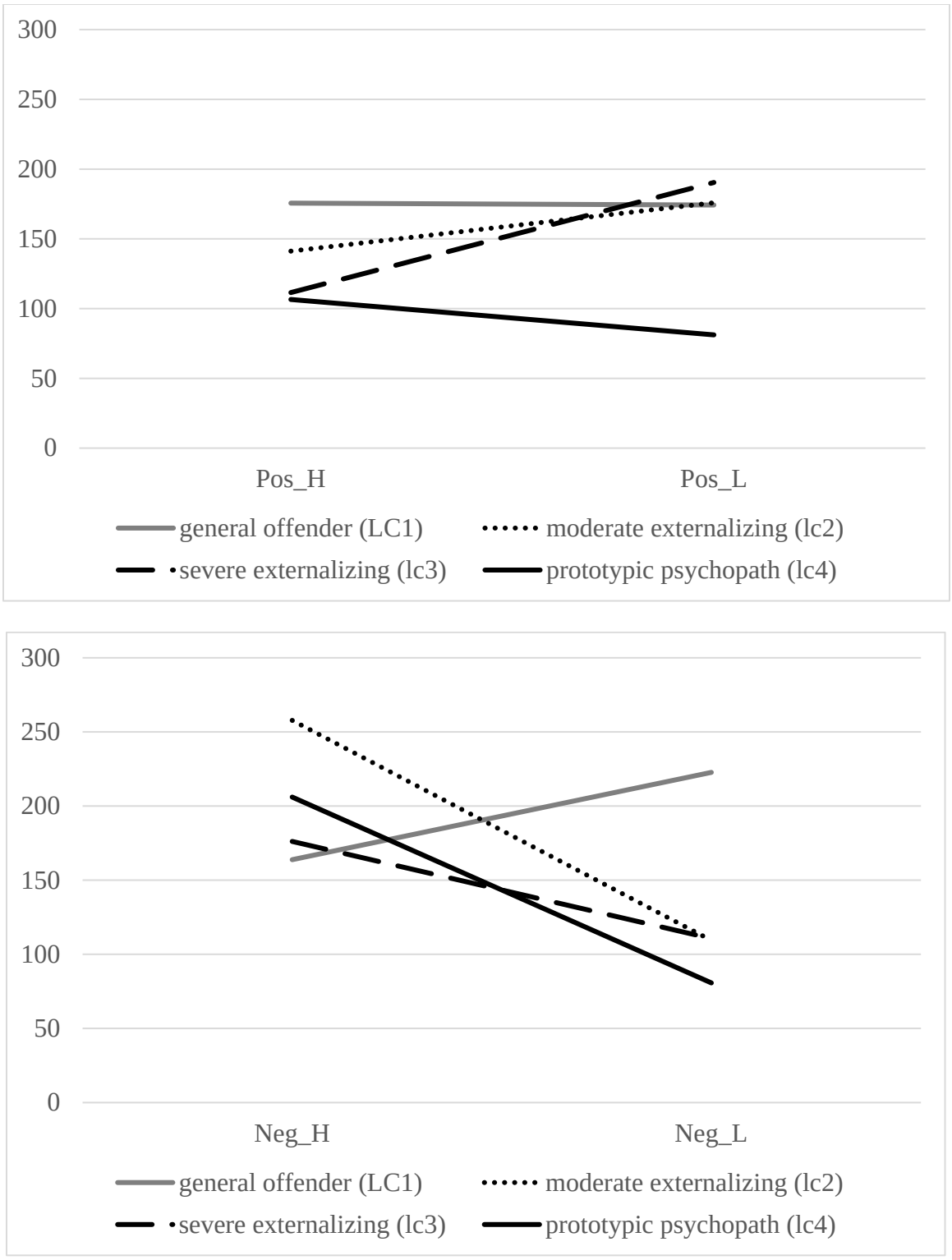


Figure 13. Significant subtype x arousal interaction within positively and negatively valenced conditions for amplitude.

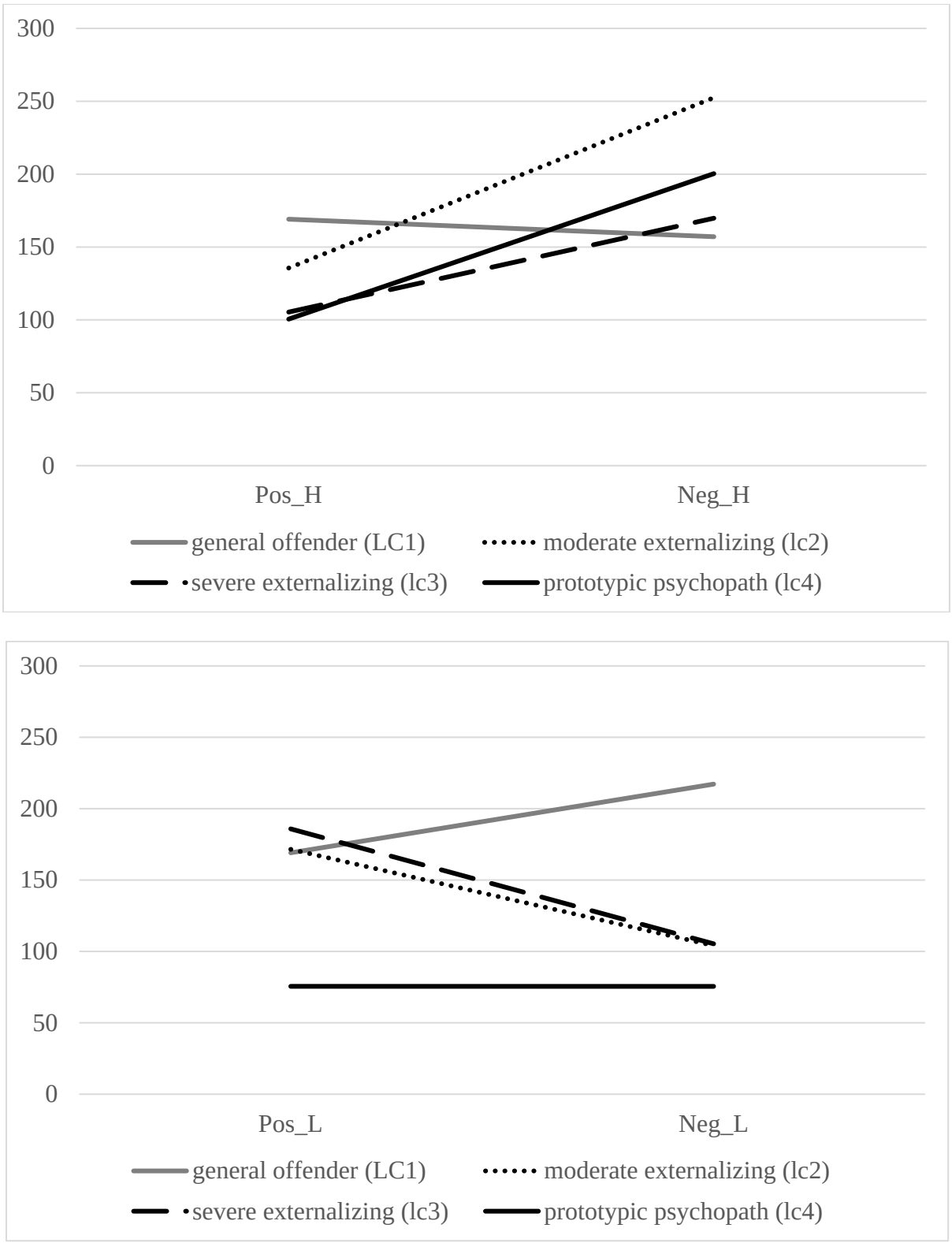
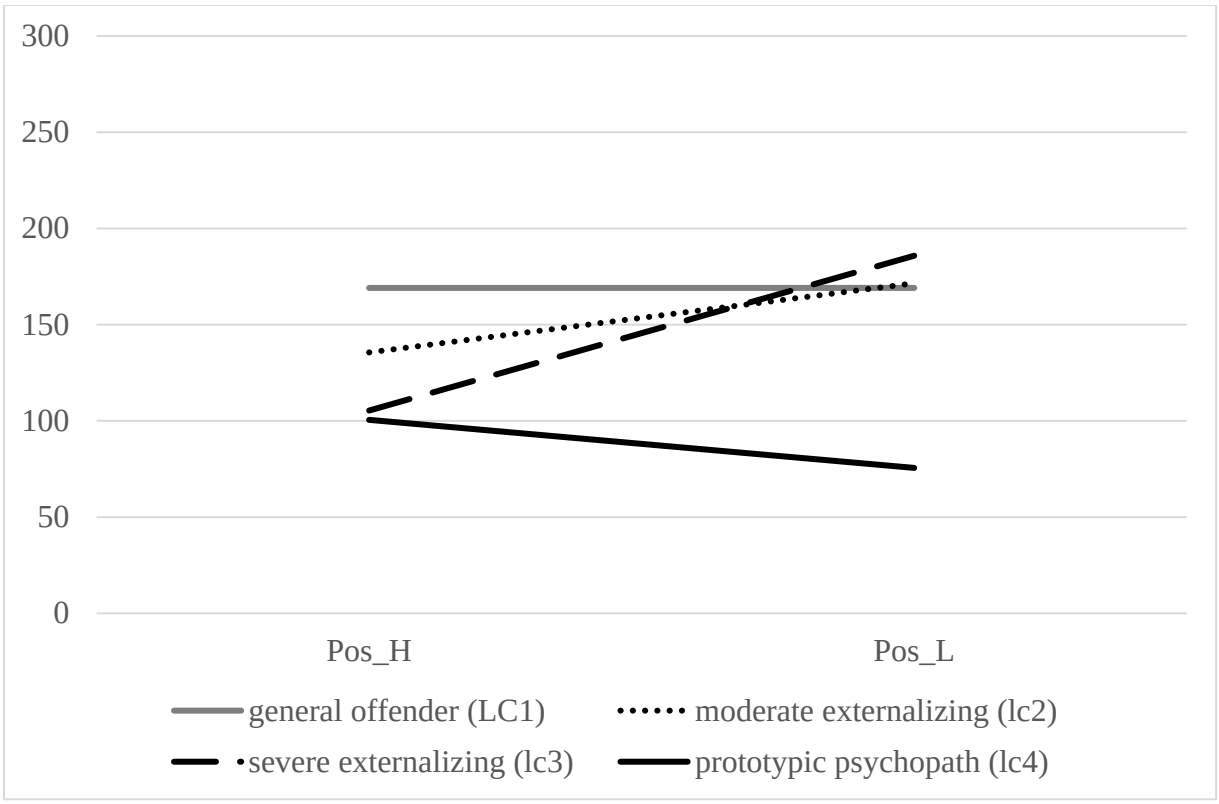


Figure 14. Significant subtype x valence interaction within high and low arousal conditions for shimmer.



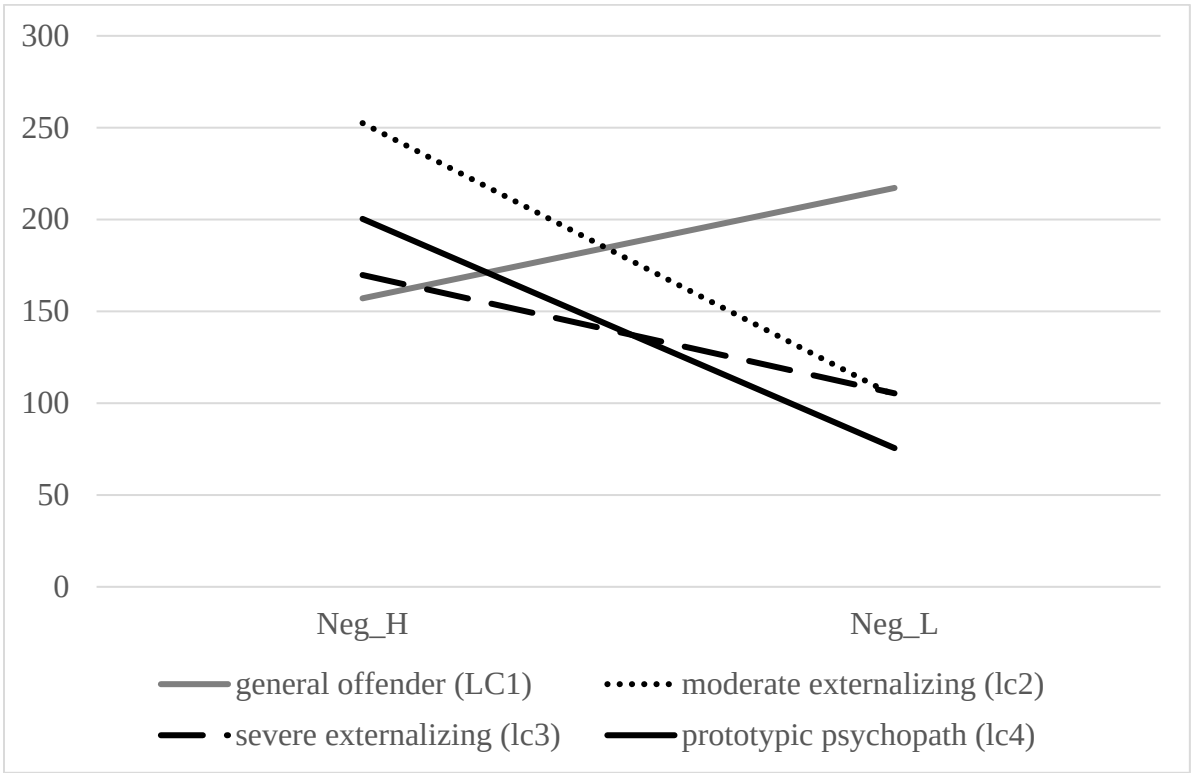


Figure 15. Significant subtype x arousal interaction within positively and negatively valenced conditions for shimmer.

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